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HANDY BOOK

FOR

THE HOSPITAL CORPS

UNITED STATES NAVY

1917

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This Handy Book for the Hospital Corps, United States Navy, revised and corrected by Passed Asst. Surg. J. B. Kaufman, United States Navy, is published for the instruction and guidance of the Hospital Corps and for use as a textbook of instruction at the Hospital Corps Training Schools.

W. C. BRAISTED,
Surgeon General, U. S. Navy.

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HANDY BOOK FOR THE HOSPITAL CORPS, UNITED STATES NAVY.

CHAPTER 1.

ANATOMY AND PHYSIOLOGY.

(NOTE.—The study of the structure and function of a complex organism, such as the human body is, can not be considered simple, even when taken up in an elementary way; furthermore, the numerous technical terms that must be used in the descriptive work will soon entangle the student in a jungle of words unless he is willing to refer frequently to medical dictionaries and books on anatomy and physiology for definitions and plates. As it is well known that descriptions, supplemented by a plate, form a much more lasting picture on the mind of a student, it is particularly recommended that the figures used in the works on anatomy be studied carefully in conjunction with this text, as a comprehensive idea of the subject can hardly be obtained without a clear mental picture of the part being studied.)

Define anatomy. Anatomy is the study of the construction of the body and the relation of the different organs and other structures to one another.

Define physiology. Physiology is the science of the functions of living bodies.

What is comparative anatomy? Comparative anatomy is the study of the construction of one species of animal in comparison with that of another species; for example, the muscles con-

trolling the movements of the external ear in a horse are well developed, allowing free movement of the pinna, while in man these muscles, though present in a rudimentary state, allow no motion, except in rare instances.

What is morbid anatomy? Morbid anatomy is the study of the diseased tissues as seen by the naked eye.

What is normal histology? Normal histology is the study of finely cut pieces of the normal tissues of the body, properly prepared and magnified, with the aid of a microscope, for the purpose of observing the minute construction of the tissues. When the tissues are diseased, this study is called pathological histology.

What is embryology? Embryology is the study of the development of the offspring, from the beginning of the germ cell in the uterus of the mother to the time of birth.

What is the unit of structure and function of all tissues of the body? A cell.

Describe a cell. A true cell is made up of a mass of protoplasm (cytoplasm), a granular semifluid or gelatinous substance, which is limited in most cases by a cell wall, and an essential organ known as a nucleus. These cells vary in shape, size, location of nucleus, size of nucleus, shape of nucleus, structure of protoplasm, staining properties, etc. Every higher organism, including man, begins as a single cell.

What is meant by the tissues of the body? The tissues are collections of cells of constant structure and function, which, although modified by situation, etc., may be always clearly identified. In certain tissues the cells are joined together or separated by a kind of cement substance known as the intercellular substance. The fundamental tissues of the body are epithelial, connective, muscular, and nervous, and are each characterized by certain peculiarities of structure and function. These tissues combine to form organs, and organs are associated into systems.

What are the epithelial tissues? The epithelial tissues are formed of different types of epithelial cells, with a small amount of intercellular substance, and make up the covering of

the mucous membranes and the free surface of the skin. There are many different kinds of epithelial cells, depending on the

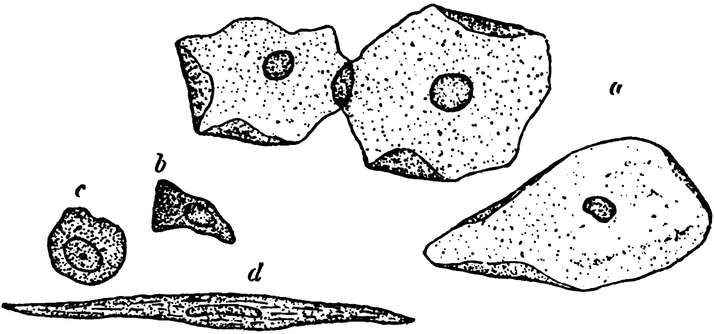


FIG. 1.—Various forms of cells. *a,* Squamous epithelium from the tongue; *b,* columnar cell from the small intestine; *c,* a polyhedral or spheroidal cell from the liver; *d,* a smooth-muscle cell from the muscular coat of the stomach. x 550. (Ferguson.)

work that is required of them. Those of the stomach that assist in digestion are very different from those found in the trachea; some are found in a single layer, as in certain parts of the kidney; others in several layers piled one on the other, as in the intestine; some contain pigment, such as the deep layers of the skin, especially in the negro; and, lastly, there are specialized epithelial cells that are sensitive to the production of certain perceptive elements and are connected with sight, hearing, smell, and taste. They serve principally for protection, secretion, and excretion.

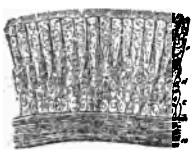


FIG. 2.—Ciliary epithelium. (Kölliker.)

What are the principal forms of connective tissue? The cells of these tissues are scanty, the intercellular substance considerable, and within the latter a new element, the connective tissue fiber, makes its appearance. The most important varieties

of connective tissue are embryonal, as found in fetal life; areolar tissue, as found immediately under the skin and between muscle fibers; dense fibrous tissue, as found in tendons, ligaments, and surrounding various organs; adipose tissue or fat; lymphoid tissue; cartilage; bone; dentine; etc.

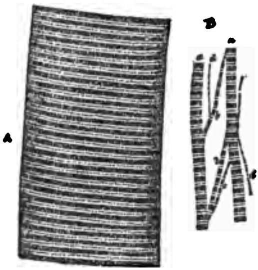


FIG. 3.—Striped muscle fiber. (Sharpey.)

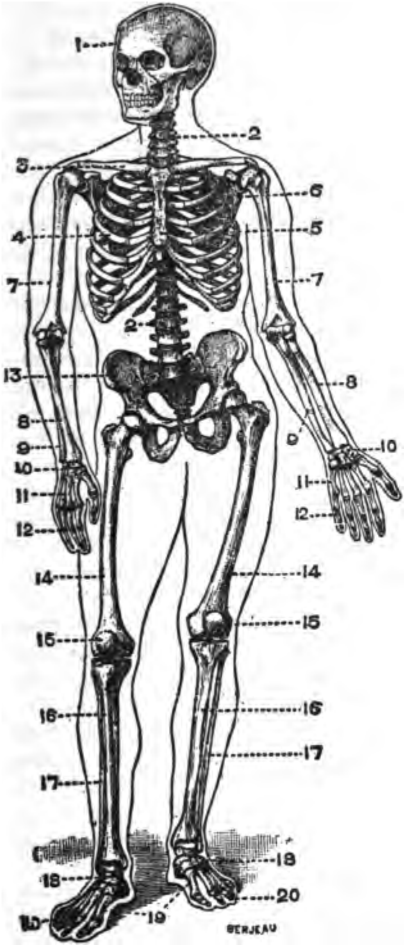
What different kinds of muscular tissues are there, and where may each type be found? 1. Voluntary striated muscles, found in all muscles that we move of our own volition, such as the biceps; 2, involuntary striated muscle, found only in the muscular substance of the heart and not under the domination of the will; 3, involuntary nonstriated muscle; this type is widely distributed, being found in the digestive tract, the respiratory tract, the ducts of the larger glands, the arteries, the iris, the genito-urinary apparatus, the lymph and sweat glands. We have no control over the action of this type of muscle and are entirely unconscious of its action.

FIG. 4.—Motor nerve cell. (Howell.)

Of what are the nervous tissues made up? Nerve cells and so-called nerve fibers for transmitting the impulses of the nerve cells. These nerve fibers are processes which extend from the nerve cell and are therefore actually a part of the cell itself. The nerve cells (neurons) are held together by a supportive connective tissue.

OSTEOLOGY AND SYNDESMOLOGY.

Define osteology. Osteology is the study of the bony framework of the body, including the study of the individual bones.



1. Cranium.
2. Vertebral column.
3. Clavicle.
4. Ribs.
5. Sternum.
6. Scapula.
7. Humerus.
8. Radius.
9. Ulna.
10. Carpus.
11. Metacarpus.
12. Phalanges.
13. Pelvis.
14. Femur.
15. Patella.
16. Tibia.
17. Fibula.
18. Tarsus.
19. Metatarsus.
20. Phalanges.

FIG. 5.—The skeleton. (Manual of Instruction, Royal Naval Sick Berth Staff.)

Define syndesmology. Syndesmology is the study of the joints of the body, taking into consideration the parts forming the joints and the movements each joint is limited to in its action.

What is the skeleton? The skeleton is the bony framework of the body. Its function is to assist in keeping the body shape, to protect certain vital organs from injury, and to form a framework for the attachment of the muscles in order that complicated movements may be effected.

How many bones are there in the body? There are 206 bones in the body. This number includes the small bones of the ear and the patellae.

What is the structure of bone? Bone is a form of connective tissue which contains certain lime salts; these salts increase in quantity as a person ages, making the bones harder but more brittle. The bones are made up of an outer shell of hard compact tissue and an inner spongy tissue, the latter being filled with large marrow cavities. This marrow is of two types, yellow, which consists almost entirely of fat, and red, which contains very little fat but is abundantly supplied with blood. The ends and facets of bones are covered by cartilage which forms the articulating surfaces of those bones and enters into the formation of joints, and all those portions of the bone which are not covered by an articular cartilage are covered by a thin, highly vascular membrane of fibrous tissue known as the periosteum. This membrane has the power of generating new bone when for some reason or other the original bone has been destroyed.

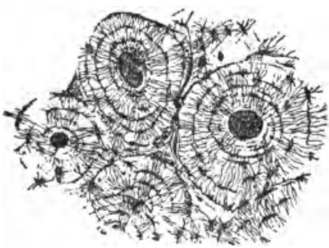


FIG. 6.—Transverse section of compact tissue of bone. Magnified about 150 diameters. (Sharpey.)

How does bone receive its nourishment? Each bone has a blood supply, usually from a small artery that enters the bone by a small opening; bone is also nourished from the numerous little capillaries contained in the periosteum.

What are the different kinds of bones? Long bones, such as the femur and humerus; short bones, such as the bones of the wrist and ankle; flat bones, such as those of the skull, the scapula, and the ribs; and irregular bones, such as the vertebræ and sacrum.

FIG. 7.—Skull. a, Nasal bones; b, superior maxilla; c, mandible; d, occipital bone; e, temporal bone; f, parietal bone; g, frontal bone. (Mason.)

How are the bones of the head divided? Into the bones of the cranium and bones of the face.

Give a short description of the cranium. The cranium is somewhat elliptical in shape, the bones forming the upper dome-shaped part being very hard in order to afford all necessary protection to the delicate brain tissue contained within its cavity; but those of the lower part or base of the cranium are thin and very irregular and are pierced by many openings called foramina, the largest of which is the foramen magnum for the passage of the spinal cord, its membranes, several of the cranial nerves, and the vertebral arteries.

Name the bones forming the cranium. The bones of the cranium are occipital, two parietals, frontal, two temporals, sphenoid, and ethmoid, eight bones in all.

What are the bones of the face? The bones of the face are 14 in number, namely, 2 nasals, 2 maxillaries, 2 lacrimals, 2 malars, 2 palates, 2 turbinates, vomer, and the mandible. The entire skull is therefore made up of 22 bones.

What are the bones of the ear? In the upper part of the middle ear there is a chain of movable bones, three in number, named the malleus (hammer), incus (anvil), and stapes (stirrup) which communicate the vibrations of the ear-drum to the internal ear.

FIG. 8.—The bones of the middle ear. M, Malleus; I, incus; S, stapes. (Howell.)

What three important cavities are formed by the bones of the face? The orbital, nasal, and oral cavities.

Describe the hyoid bone. This is known as the lingual bone, and can be felt in the middle line of the neck just below the chin. It is shaped like a horseshoe and gives attachment to various muscles, some of which are concerned in deglutition and respiration. It is occasionally broken as the result of throttling and is frequently found fractured in those who have been hanged.

What is the spinal column? The spinal column or vertebral column is a series of bones placed one on the other, extending from the base of the skull to the interval between the buttocks, and forms what is commonly known as the backbone.

How many bones are there in the spinal column and what are they called? There are 33 bones in the spinal column, the individual bones being called vertebræ. They are divided into the cervical vertebræ, 7 in number, situated in the region of the neck; 12 thoracic vertebræ situated at the back of the chest; 5 lumbar situated at the back of the abdomen; 5 sacral and 4 coccygeal, the sacral and coccygeal entering into the formation of the pelvis.

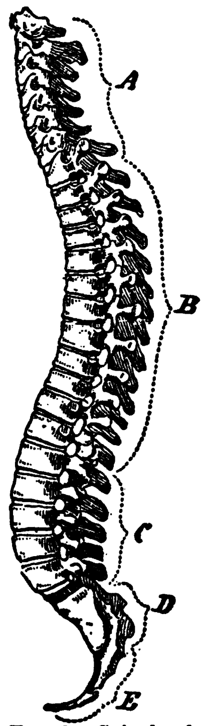


FIG. 9.—Spinal column. *A*, Cervical; *B*, dorsal; *C*, lumbar; *D*, sacrum; *E*, coccyx. (Mason.)

Give a short description of the vertebral (spinal) column. The vertebral column is a series of bones placed one on the other with the intervention of cartilages. The bones forming this column are irregular in shape, having a body from which is projected an arch forming the spinal canal for the reception of the spinal cord and its membranes. Between the arches of these bones there are small openings for the exit of the spinal nerves coming from the spinal cord.

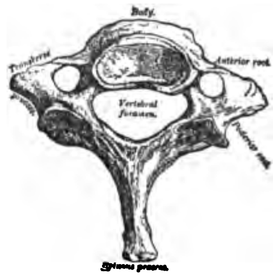


FIG. 10.—Seventh cervical vertebra. (Gray.)

What are the true and false vertebræ? True vertebræ are those that remain movable throughout life and are those of the cervical, thoracic, and lumbar regions. False vertebræ are those that become fused in adult life and form one bone, as exemplified by the sacrum and coccyx.

What are the curves of the vertebral column? Looking at the vertebral column from the side we notice several curves. In the region of the neck there is a slight curve forward, in the thoracic region there is a marked curve backward, in the lumbar region a curve forward again; then the sacrum makes a sharp curve backward, then forward, and ends with the coccyx pointing forward. There are no lateral curves in the normal spinal column.

What terms are used to describe the relation of one part to another in anatomy? Anterior, in front of, sometimes spoken of as ventral; posterior, in back of, or dorsal. On one side or the other is called lateral; the outside is referred to as external and inside as internal; on top is superior and below is inferior.

Give a short description of the bony chest. The bony chest, or thorax, is formed by the thoracic vertebræ posteriorly, by the ribs laterally, and by the cartilages of the ribs and the sternum or breast bone in front. It is conical in shape, being

smaller above than below, and is flattened on its anterior and posterior surfaces. Its purpose is to protect the vital organs of respiration and circulation that are contained within its cavity.

Give a short description of the ribs. The ribs are flat, elastic arches of bone, 24 in number, 12 on either side. They are called true, false, and floating. The true ribs are connected with the breast bone by a cartilage and are seven in number on either side. The cartilages of the eighth, ninth, and tenth ribs are fused together and are therefore called false ribs; the eleventh and twelfth ribs have no cartilages and are therefore called floating ribs.

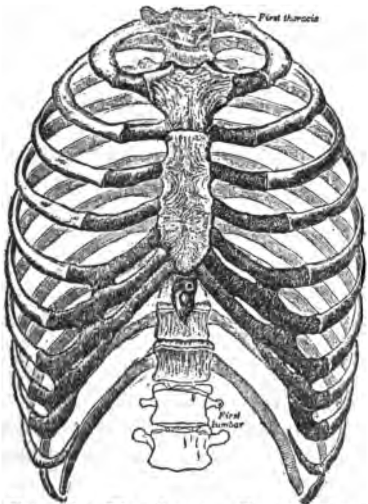


FIG. 11.—The thorax. Ventral view. (Gray.)

Describe the breast bone. The breast bone is a flat bone formed of three parts and situated in the median line of the front of the chest. It is called the sternum. The upper part of the bone, called the manubrium, is triangular in shape, the apex of the triangle joining the middle part of the sternum. The base of the manubrium has notches on either side for articulation with either clavicle. Immediately below this articulation is a notch for the cartilage of the first rib, and near the apex is another notch for the reception of part of the cartilage of the second rib. The second piece of the sternum is called the gladiolus and joins the manubrium above and the third part of the breast bone below, called the ensiform cartilage. The lateral borders of the gladiolus are notched for the

reception of the cartilages of the third, fourth, fifth, sixth. and part of the second and seventh ribs. The third part of the sternum, or ensiform cartilage, is a small, thin piece of bone, cartilaginous in youth, that extends from the lower end of the gladiolus. Its upper border is notched for the reception of the cartilage of the seventh rib.

Name the bones of the upper extremity. The bones of the upper extremity are the shoulder bones, clavicle and scapula; the bone of the arm, or humerus; those of the forearm, ulna and radius; the 8 bones of the wrist, called carpal bones; and 5 metacarpals and 14 phalanges in the hand.

Give a short description of the clavicle. The clavicle, or collar bone, is a long bone situated above the first rib anteriorly and extends from the upper border of the sternum to the acromion process of the scapula. This bone is somewhat S-shaped, curves forward at its internal end and backward externally. Internally it is bound to the upper border of the sternum by the ligaments of the sterno-clavicular articulation and externally to the acromion process of the scapula by the acromio-clavicular ligaments. It is also held firmly in position by the costo-clavicular and rhomboid ligaments. The principal muscular attachments are auxiliary muscles of respiration and the great muscle of the shoulder, namely, the deltoid. The function of the clavicle is to hold the shoulders backward, this maintaining the erect posture. Fracture of this bone causes the shoulder to fall downward, inward, and forward.

Describe the scapula. The scapula or shoulder blade is a flat triangular bone, situated in the upper, lateral, and posterior aspect of the trunk, its inner border being about 1 inch from the vertebral column. On its posterior surface it has a spine that terminates externally in a large process of bone called the acromion process, which articulates with the outer end of the clavicle; above and below this spine are smooth surfaces of bone called fossæ. From the upper and external border there is another hooklike process called the coracoid process, and inferior to both the coracoid and acromion processes is a

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smooth concave surface, called the glenoid fossa, for articulation with the head of the humerus.

The anterior surface of the scapula is smooth and is practically covered with the subscapularis muscle.

There are 17 muscles attached to the scapula, their principal actions being as auxiliary respiratory muscles; moving the arm and moving the head.

Describe the humerus. The humerus is a long bone having a shaft and two extremities, and is situated between the shoulder and elbow. The upper extremity, or head, is smooth and hemispherical, and articulates with the scapula, forming the shoulder joint. Just below the head of the bone is the anatomical neck, to which is attached the capsular ligament of the shoulder joint. Below the anatomical neck are two knobs known as the greater and lesser tuberosities, to which are attached the muscles holding the bone in place and assisting in the action of the joint. Below the tuberosities is the shaft of the bone, the first part of which is called the surgical neck, because of the frequency of fracture occurring at this point. The shaft is round in the upper part, but becomes flattened in the lower one-third and terminates in the surfaces that articulate with the ulna and radius. Above the front part of the surface which serves for the articulation of the ulna there is a small depression which receives the coronoid process of the ulna when the forearm is flexed on the arm, and on the back part of this same surface is a deep depression called the olecranon fossa which receives the tip of the olecranon process of the ulna when the forearm is extended. On either side of these articular surfaces there are projections of the bone which are called the external and internal condyles, the latter being much more prominent; these serve principally for the attachment of those groups of muscles which have for their function flexion, extension, pronation, and supination.

Describe the bones of the forearm. The forearm is that part of the upper extremity which is situated between the elbow and the wrist, and its skeleton is made up of the ulna and the radius. These are both long bones, the ulna being placed on the

inner and the radius on the outer side of the forearm. They are both prismatic in shape, the ulna being largest at the elbow and very small at the wrist, while the reverse is true of the radius. On the upper extremity of the ulna there are two prominent eminences, the olecranon process and the coronoid process, and two cavities, the greater and lesser sigmoid cavities. The olecranon process is situated on the upper and back part and forms the projection which is incorrectly called the elbow; the coronoid process is situated on the upper and front part of the bone. The cavity in the bone which occupies the position between these two processes is known as the greater sigmoid cavity and serves for articulation with the humerus. Below this cavity and external to the coronoid process is the lesser sigmoid cavity which articulates with the head of the radius, the bones being held together at this point by a slinglike ligament which passes from the borders of the cavity to the head of the radius below by an anterior and posterior ligament. Both bones articulate above with the humerus to form the elbow joint. The shafts of the bones are separated by a tough membrane called the interosseous membrane.

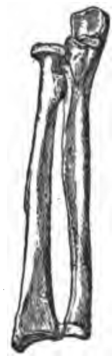


FIG. 12.—Radius and ulna. (Mason.)

Projecting internally from the lower extremity of the ulna is a process of bone known as the styloid process, which is the lowest part of the bone and can be easily demonstrated; there is a corresponding projection on the external surface of the radius at its lower extremity which is likewise called the styloid process. The lower extremities of the two bones articulate with one another, but the radius alone enters into the formation of the wrist joint by articulating at its lower extremity with the scaphoid and semilunar (carpal bones), the ulna being separated from this joint by a cartilage.

The muscles having their origin on the anterior surfaces of the bones of the forearm are inserted into the phalanges, their

action being to flex the hand. Those having their origin on the posterior surfaces are attached to the back of the phalanges, their action being to extend the hand. There are also muscles attached to these bones for the purpose of supinating and pronating the hand.

What are the bones of the wrist? The bones of the wrist are called carpal bones and are arranged in two rows. In the upper row from the radial to the ulnar side are the scaphoid, semilunar, cuneiform, and pisiform; the lower row consists of the trapezium, trapezoid, os magnum, and unciform in the same order.

What are the bones of the palm? These are called metacarpal bones and are five in number, being numbered in order, the first being that of the thumb and the fifth that of the little finger.

What are the bones of the fingers? These are known as phalanges, there being fourteen of them, three for each finger and two for each thumb. They are named as well as numbered, the one nearest the wrist in each finger being called the first or proximal phalanx, the next the second or middle phalanx, and the terminal one the third or distal phalanx. The first phalanges articulate with the corresponding metacarpal bones.

FIG. 13.—Pelvis (adult). (Gray.)

Give a short description of the bony pelvis. The bony pelvis consists of the two hip bones, or ossa innominata, the sacrum, and the coccyx. The hip bones are irregular in shape and are made up of three segments called the ilium, pubis, and ischium. The former is the broad, flat part of the bone, the crest of which is commonly spoken of as the hip. It articulates posteriorly with the sacrum. The pubic portion is angular and forms

that part of the pelvis which, with its fellow on the opposite side, makes the bony arch anteriorly that is called the symphysis pubis. The third portion of the os innominatum, called the ischium, is also angular, the angle being that portion of bone which the body rests upon when in the sitting posture, and is called the tuberosity. These three portions of bone unite to form the acetabular cavity and the obturator foramen or opening; the former for articulation with the femur, forming the hip joint; the latter for the passage of vessels and nerves.

There are several important bony landmarks on the os innominatum with which one should be familiar. The crest of the ilium which terminates anteriorly in the anterior superior spine and which is easily recognized; upward and outward from this may be felt the curved outline of the crest terminating posteriorly in the posterior superior spine which shows as a depression at about the level of the second sacral vertebra; the tuberosity of the ischium, which can be felt easily if the hip is flexed and is located just below the fold of the large muscle making up the greater part of the buttocks; the spine of the os pubis which is situated on the external part of the upper border of the body of the pubic bone in the region of the symphysis pubis.

The muscles attached to the pelvis are those of the abdominal walls and back, above; and the muscles moving the thigh and leg, to the sides and below.

Describe the femur. The femur, or thigh bone, is a long bone situated between the hip and knee joints. It has a shaft and two extremities. The head is hemispherical in shape and fits into the acetabular cavity of the os innominatum. Below the head is the neck of the bone which forms an obtuse angle with the shaft, and where it joins the shaft forms two bony prominences, the upper and larger being the greater trochanter, the lower the lesser trochanter.

The shaft is cylindrical in its upper and middle portions, but expands at its lower extremity into two large eminences called condyles, separated in front by a smooth depression (trochlea) and behind by a well-marked notch. The trochlea and inferior

surface of the condyles form the surfaces with which the patella and tibia articulate in forming the knee joint. On the outer surface of the external condyle and the inner surface of the internal condyle there are found projections on the bone which give attachment to the lateral ligaments of the knee and are known respectively as the outer and inner tuberosities.

FIG. 14.—Tibia and fibula. (Mason.)

Describe the bones of the leg. The bones of the leg are the tibia, or shin bone, and the fibula. They are both long bones. The fibula is placed external to the tibia, and is a slender bone articulating above with the external tuberosity of the tibia and below with the tibia and the astragalus, forming part of the ankle joint. The tibia is much larger than the fibula and is prismatic in shape, being larger above than below. Its upper expanded portion forms two tuberosities, called external and internal, respectively. The shaft is triangular in shape, the anterior angle forming the ridge of bone easily felt in the front of the leg, called the shin. The tibia articulates below with the astragalus, the three bones, fibula, tibia, and astragalus, forming the ankle joint.

FIG. 15.—Right elbow-joint, cut through at right angles to the axis of the trochlea humeri, from the ulnar side. (Spalteholz.)

Like the bones of the forearm, the tibia and fibula have a membrane stretched between them in the interval called the interosseous membrane, but unlike the bones of the forearm there is no motion existing between the fibula and tibia. The muscles arising on the bones of the leg are for the movements of the ankle and foot.

Describe the kneecap. The kneecap or patella is a flat bone, of triangular shape, placed in front of the knee joint. It is usually regarded as a sesamoid bone, which is the general name given to those bones which develop in tendons that glide over certain parts and exert a great amount of pressure. The patella develops in the tendon of the great extensor muscle situated on the front of the thigh and known as the quadriceps extensor. This muscle is continued from the lower part of the patella as a tendon, called the ligamentum patellæ, and is inserted into the tuberosity of the tibia.

What are the tarsal bones? The tarsal bones are seven in number, namely, the astragalus, os calcis, cuboid, scaphoid, and internal, middle, and external cuneiform bones.

Describe the remaining bones in the foot. These in number, naming, and general arrangement correspond with those in the hand, except that instead of metacarpal we name the corresponding bones in the foot the metatarsal.

What are the three types of joints? The three types of joints are (1) the immovable joint, such as the sutures of the skull; (2) the partly movable joints, this type being found where the front of the pelvic bones join in the symphysis pubis; (3) the true, or movable joint, such as the shoulder and hip joints.

What are the different types of movable joints? They are the gliding, such as is found in the spine; the ball and socket type, such as the hip and shoulder; the hinge joint, exemplified by the ankle and elbow; the rotary joint, found between the first and second vertebræ, and saddle joints like that of the trapezium and first metacarpal bone.

In the description of a joint what is to be considered? (1) Name of the joint; (2) the type, such as hinge or ball and socket; (3) the bones and parts of bones entering into its formation; (4) the ligaments; (5) the synovial membrane; (6) the synovial fluid; (7) the movements of the joint; (8) the muscles acting on the joint.

What is the synovial membrane? The synovial membrane is a thin membrane lining joints; it is not connected with the

external air and resembles in structure the peritoneum and pleura; it is lubricated by the synovial fluid, thus forming a smooth, well-oiled surface for free action of the joint.

THE MUSCLES.

How are the muscles of the body divided for the purpose of description? Into those of the face, head, and neck, those of the trunk, those of the upper extremity, and those of the lower extremity.

Of what do the muscles of the head and face consist and what is their action? The muscles of the head and face consist of numerous groups of small muscles, and have for their action the movements of the eyes, face, scalp, and assist in deglutition, talking, drinking, singing, and expression.

What is the action of the muscles of the neck? The muscles of the neck move the head from side to side, forward and backward, and rotate it; they also act as auxiliary muscles of respiration, assist in deglutition, speaking, and all other complicated motions of the head and neck not included in the actions of the muscles of the face.

How are the muscles of the trunk divided? Into those of the back, thorax, abdomen, and perineum. The muscles of the back are arranged in five layers, and, acting on the spinal column, keep the trunk in the erect posture when sitting or standing. Those of the thorax are the muscles of respiration, and include the diaphragm, the great muscle that divides the abdomen from the thorax. The muscles of the abdomen are arranged in three layers and form the sides and front of the belly wall; they assist micturition and defecation. The name "Poupart's ligament" is given to a part of the attachment of one of the muscles of the abdomen (external oblique) extending from the anterior superior spine of the ilium to the spine of the pubis.

The muscles of the perineum are those surrounding the root of the penis and the rectum. Their action is to assist in micturition and defecation.

How are the muscles of the upper extremities divided? Into those of the shoulder, their action being to move that joint; those of the arm, forearm, and hand. The muscles on the front of the arm flex the forearm; those on the back extend it. The same applies generally to muscles arising on the forearm and attached to the fingers, some of the muscles going from the arm to the forearm pronate (turn the palmar surface down), others supinate (turn the palmar surface upward), the hand.

FIG. 16.—Muscles of the thorax and front of the arm. Superficial view. (Gray.)

How are the muscles of the lower extremity divided? Into the muscles of the hip, thigh, those of the leg, and those of the foot.

What is the action of the muscles of the hip? Those on the anterior surface flex the thigh on the abdomen; those on the posterior surface extend it; the muscles on the internal side adduct or bring the thigh toward the middle line; and those on the external side abduct or draw the thigh away from the middle line.

What is the action of the muscles attached to the leg? Those attached to the upper and back part of the leg, called hamstring muscles, flex the leg on the thigh; those attached to the upper anterior surface, by one large tendon, called the ligamentum patellæ, extend the leg; and those having their origin on the anterior and posterior surfaces of the bones of the leg and inserted into the bones of the foot flex and extend the foot, respectively.

To what is the contraction of a muscle due? It is due to the nerve impulse being received either from the brain or spinal cord, and, muscle tissue being sensitive to nerve impulses, a contraction occurs; during contraction the muscle changes shape, becoming shorter and broader; there is a slight shrinking in volume, and there is an increased production of carbon dioxid (CO_2) and absorption of oxygen.

THE CIRCULATORY SYSTEM.

Describe the heart. The heart is a hollow muscular organ, pyramidal in shape, located in the front and center of the thoracic cavity, and extends from the second costal cartilage above to the interval between the fifth and sixth ribs on the left side, and from about one-half inch to the right of the right border of the sternum to about three-quarters of an inch to the left of the left border of the sternum. Its base is directed upward, backward, and to the right, while the apex is directed downward and to the left.

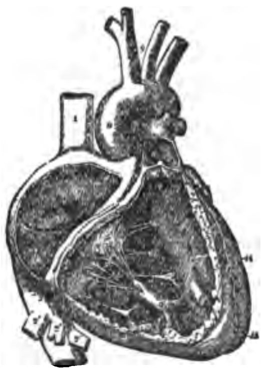


FIG. 17.—Heart, with right auricle and ventricle opened. (Allen Thomson.)

The heart is inclosed in a serous membrane sac called the pericardium, and this membrane is reflected over the outer surface of the organ; between the two surfaces is a small quantity of fluid called the pericardial fluid, which lubricates the surfaces and prevents friction during the movements of the heart. The inside of the heart is also lined with a serous membrane called the endocardium. The muscular portion of the heart is called the myocardium, and is made up of branched involuntary muscular fibers.

How is the heart divided into its cavities? The heart cavity is subdivided by a longitudinal muscular septum into two lateral halves known, respectively, as the right or venous heart, as it deals only with venous blood, and the left or arterial heart,

as it deals only with arterial blood. Each of the halves is further subdivided by a transverse septum into two cavities, the upper ones being known as the auricles and the lower the ventricles, right and left. There is no direct communication between the right and left side of the heart, but each auricle communicates with its corresponding ventricle through an oval aperture known as the auriculo-ventricular opening, right and left. Each of the cavities of the heart is lined by the endocardium, and by the folding upon itself of this membrane there are formed the valves of the heart which guard the various cardiac orifices, the number and shape of the cusps or segments that make up these valves depending upon the location. At the auriculo-ventricular orifice on the right side the valve consists of three cusps of a triangular shape and is known as the tricuspid valve, while on the left it consists of two triangular cusps and is known as the bicuspid or mitral valve. At the orifice of the pulmonary artery the valve consists of three half-moon shaped segments and is known as the pulmonary semilunar valve, while at the orifice of the aorta the valve is of similar structure and is known as the aortic semilunar valve.

Describe the circulation of the blood through the heart. The impure blood, returning from the general circulation, enters the right auricle by way of the superior and inferior venæ cavæ, and from here passes through the right auriculo-ventricular opening to the right ventricle, which when filled contracts, sending the blood through the pulmonary artery, the tricuspid valve having closed to prevent the blood from passing back into the right auricle, to the lungs. After being purified in the lungs the blood returns to the left auricle via the pulmonary veins, passes through the left auriculo-ventricular opening to the left ventricle, and this, contracting, forces the blood out into the aorta for distribution throughout the body, the mitral valves having been closed to prevent return to the left auricle.

Explain the action of the heart in pumping the blood throughout the body. There are three periods in what is called the cardiac cycle. First, the contraction of the auricles forcing the blood into the ventricles; second, the contraction of the

ventricles, forcing the blood into the aorta and pulmonary artery; and, lastly, a period of rest. This cycle is repeated 72 times per minute in the normal adult. The contraction of any part of the heart is known as its systole, its relaxation and period of rest as its diastole.

Describe an artery. An artery is an elastic tube made up of three coats, the middle one being made up of involuntary muscular fibers. The walls of arteries are much thicker and more elastic than those of veins. Arteries carry pure blood to be distributed throughout the body, with the exception of the pulmonary artery, which carries the impure blood from the right ventricle to the lungs.

Describe the aorta. The aorta, the beginning of the arterial system, is the largest artery in the body and begins at the aortic opening of the left ventricle, ascends for a short distance, arches backward, then passes downward on the left side of the spinal column through an opening in the diaphragm, and at the level of the fourth lumbar vertebra divides into the right and left common iliac arteries. Hence it is divided into the ascending aorta, the arch of the aorta, and the descending aorta, the latter being again divided into that part contained in the thorax known as the thoracic aorta, and that part found in the abdomen known as the abdominal aorta.

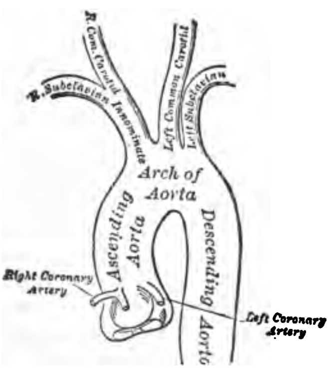


FIG. 18.—Plan of the branches of the arch of the aorta. (Gray.)

What are the branches of the ascending aorta? The right and left coronary arteries which arise near the beginning of the aorta and supply the heart with blood.

What are the branches of the arch of the aorta? The innominate artery, which arises at the commencement of the arch

and soon divides into the right common carotid and right subclavian, the left common carotid, and left subclavian.

What region do the carotid arteries supply? The carotid arteries pass upward on either side of the front of the neck, dividing into the external and internal carotid arteries. The former supplies the face and scalp, the latter supplies the interior of the cranium and brain.

What region do the subclavian arteries supply? The subclavian artery passes outward over the first rib to the axilla, where it becomes the axillary artery, and this artery in turn becomes the brachial as it passes beyond the armpit. The brachial artery passes down on the inside of the arm along the border of the biceps muscle to the bend of the elbow, where it divides into the radial and ulnar, and these in turn pass down on either side of the forearm to the wrist and hand, terminating in the superficial and deep palmar arches. This series of arteries supplies the muscles of the chest, arm, forearm, and hand. The subclavian artery also gives off a branch called the vertebral for the supply of the spinal cord and brain, and a second branch supplying the thyroid gland.

What are the branches of the thoracic aorta? They are the bronchial, which are the nutrient vessels of the lungs; the esophageal, supplying the esophagus; the pericardial, supplying the pericardium; and numerous small branches which supply the ribs and muscles between them, as the intercostals.

What are the branches of the abdominal aorta? The phrenic arteries, right and left, which supply the diaphragm; the celiac axis, which divides into the gastric for the stomach, the hepatic for the liver and gallbladder, and the splenic, which supplies the pancreas and spleen; the suprarenals, right and left, which supply the suprarenal glands; the superior and inferior mesenterics, which supply the large and small intestines; the renals, right and left, which supply the kidneys; the spermatics (ovarians in female), right and left, which supply the spermatic cord; and various muscular branches (lumbar) which supply the lumbar muscles.

How do the iliac arteries divide? They divide into the external, which gives off several branches for the supply of the abdominal muscles and becomes the femoral artery at the upper border of the front of the thigh; and the internal iliac which supplies the pelvic organs and by its sciatic and gluteal branches supplies the muscles at the back of the thighs.

What becomes of the femoral artery? It passes down the front and inner side of the thigh, giving off numerous branches to the muscles and the femur, then passing through Hunter's canal, a membranous sheath in the adductor muscles, to the back of the knee, becomes the popliteal artery. The popliteal artery passes downward, and just below the back of the knee divides into the anterior and posterior tibial. The former passes forward between the tibia and fibula, then down the front of the leg to the ankle, where it becomes the dorsalis pedis artery and supplies the back of the foot. The posterior tibial passes down the back of the leg and at the inner side of the ankle passes to the plantar surface of the foot, where it divides into the internal and external plantar arteries for the supply of the muscles and skin of the foot.

FIG. 19.—Valves of a vein. In the lower part of the figure are seen the parietal valves; the upper part shows the mouth of a vein guarded by a valve. (Poirier and Charpy.)

Describe a vein. A vein has much the same structure as an artery, except the coats are thinner. Veins usually have valves to support the column of blood, as most of the force of the cardiac impulse is lost during the course of the blood through the capillaries.

What is the capillary system? The capillary system is a network of very fine tubes about 1/2000 of an inch in diameter, extending over the entire body. The blood passing through these fine tubes gives off nourishment to the different organs and structures of the body.

Into what three sets may the veins be divided? Into the pulmonary veins, the systemic veins, and the portal system.

What are the pulmonary veins? They are the veins that collect the blood after it has been aerated in the lungs and return it to the left auricle.

What are the systemic veins? The systemic veins are arranged in two sets, deep and superficial; the deep veins accompany their corresponding arteries, each of the large arteries of the leg, forearm, and arm having two veins; the deep veins communicate with the superficial set. The superficial veins lie just under the skin, where they can, in many localities, be plainly seen; those of the lower extremity are the internal saphenous, which starts on the top and inner side of the foot, runs up the inside of the leg and thigh, and terminates in the femoral just below the groin, and the external saphenous, starting in like manner on the outer side of the foot and emptying into the popliteal behind the knee.

Those of the upper extremity are the radial on the outer side, the ulnar on the inner side, and the median in the middle; opposite the bend of the elbow the median splits into two veins, the one, known as the median cephalic, joining with the radial to form the cephalic, and the other, the median basilic, uniting with the ulnar to form the basilic; the basilic and cephalic both empty into the axillary. The median cephalic is the vein ordinarily opened in bleeding. The great superficial vein of the neck is the external jugular, which passes down from the angle of the jaw to the middle of the clavicle; it may be brought into view by pressing with the finger just above the middle of the clavicle. All of the venous blood from the whole of the upper half of the body is conveyed to the heart through the superior vena cava, while the inferior vena cava returns the blood from the lower part of the body; the two venæ cavæ are connected by certain veins known as azygos veins, which collect the blood from most of the intercostal spaces.

What is the portal system of veins? The portal system is composed of four large veins which collect the venous blood from the viscera of digestion. The trunk formed by their union (vena porta) enters the liver and breaks up into capillaries from which another set of veins—the hepatic veins—

arise, which terminate in the inferior vena cava. This circulation is for the purpose of subjecting the products of digestion contained in these veins to the special action of the liver before they go into the general circulation.

Describe the blood. The blood is composed of a liquid part known as the plasma, or liquor sanguinis, in which float a vast number of microscopical bodies known as blood corpuscles. The reaction is neutral and the specific gravity 1.055.

Describe the blood plasma. Blood plasma when obtained free from corpuscles is straw colored, or if in extremely thin layers is practically colorless. It contains a substance, fibrin in solution, known as fibrinogen, and when blood is exposed to the air, as in the case of certain wounds, the fibrin is formed from the fibrinogen and precipitated; the active element in causing this precipitation is a substance known as prothrombin (fibrin ferment) which is believed to be liberated by the blood platelets. The blood cells become entangled in this fibrin, forming a clot. This fibrin can be removed from blood during the time of clotting by vigorously whipping the blood with switches, when the fibrin will be deposited upon the whip and no clot will form (known as defibrinated blood).

Name the cellular contents of the blood. There are two kinds of corpuscles in the blood, known respectively as the red blood corpuscles or erythrocytes, and the white corpuscles or leukocytes. A third body found in the blood plasma is the blood platelet.

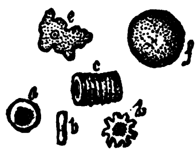


FIG. 20.—*a, b, c, d,* Red cells, side, edge, in rouleaux, crenated; *e, f,* white cells. (Mason.)

Describe the erythrocyte. The erythrocyte is a biconcave, circular disk about 1/3200 of an inch in diameter, has no nucleus, and is therefore not a true cell. Their number, which is usually reckoned as so many in a cubic millimeter, varies greatly under different conditions of health and disease, but is given as 5,000,000 in a cubic millimeter. The red color of the corpuscles is due to the presence in them of a substance known as hemoglobin, which has the power of com-

bining easily with oxygen to form oxyhemoglobin, a loose chemical combination by which oxygen is carried from the lungs to the tissues and which gives the brighter red color to the arterial as compared with the venous blood. It possesses also the power in the same way of removing the carbon dioxid from the tissues. In the adult the organ for the reproduction of the red blood cells is the red marrow of bones. Here these cells are nucleated, but lose their nuclei when presented to the blood proper. A large number of red corpuscles are destroyed daily in the body, but just when and how the corpuscles go to pieces is not definitely known.

Describe the leukocytes. The white blood corpuscles are all nucleated cells varying in shape and size, measuring on the average about 1/2500 of an inch in diameter, and are present in normal blood to the extent of 8,000 in a cubic millimeter. Leukocytes have the striking property of migrating to the surrounding tissues, and furthermore they serve to protect the body from bacteria and other foreign substances by ingesting these or by forming certain substances which destroy them. Leukocytes that act by ingesting bacteria are termed phagocytes. It is difficult to differentiate the different kinds of leukocytes in unstained blood and therefore various stains are used to bring out the characteristics of the several kinds of leukocytes. The use of Wright's stain, or some modification of Romanowsky's stain, will be found practicable throughout the service, and frequent stains should be made of normal blood in order to become thoroughly familiar with the appearance of these cells. The points of differentiation in the following are from blood stained with Wright's stain.

The following types of leukocytes are recognized: (1) Lymphocytes. (2) Nongranular leukocytes. (3) Granular leukocytes.

Lymphocytes.—There are two main varieties, large and small; the small lymphocyte is about the size of a red-blood corpuscle with a large round nucleus, centrally placed, which stains a deep violet, and has a very narrow zone of protoplasm often

amounting to only a fringe around the nucleus. The cytoplasm stains a deep blue. These cells are easily recognized and constitute from 20 to 25 per cent of all the leukocytes found in normal blood. The large lymphocyte is of the same type as the preceding, but is much larger and possesses more cytoplasm. The nucleus takes a fairly deep violet stain and the protoplasm a fairly deep blue, which, however, is not as deep as that of the small lymphocyte. This cell needs to be differentiated from the large mononuclear and constitutes from 5 to 10 per cent of all the leukocytes in normal blood. The lymphocytes, for the most part, take origin in the lymph organs (also from spleen and bone marrow), and hence their name.

Nongranular leukocytes.—Included under this group are the large mononuclear and the transitional. The large mononuclear is of the same general shape as the preceding, but the nucleus has lost the richness of the violet stain and appears washed out, while the cytoplasm presents a frosted-glass appearance, in contradistinction to the clear-glass appearance in the large lymphocyte. In normal blood they constitute about 1 to 2 per cent of the total leukocytes. The transitional is of the same general shape as the preceding and the most popular belief is that it is the large mononuclear which is beginning to disintegrate. Its staining properties are those of the large mononuclear, but it presents a more washed-out appearance, with a nucleus that is characteristically indented on one side. In normal blood they constitute about 2 to 4 per cent of all the leukocytes.

Granular leukocytes.—These comprise three varieties distinguished on the basis of the granules contained in their cytoplasm; (1) polymorphonuclear or neutrophile; (2) eosinophile (acidophile or oxyphile); (3) basophile or mast cell.

Polymorphonuclear.—This word means many-shaped nucleus and does not characterize the neutrophile, but applies equally well to other varieties of granular leukocytes. The nucleus assumes many shapes, reminding one of the various letters of the alphabet and often the strands of nuclear matter connect-

ing the nuclear masses is so delicate as to give the impression that we are dealing with separate nuclei in the one cell. The neutrophiles are larger than a red corpuscle, the nucleus stains lilac while the cytoplasm stains pink and contains many fine granules which take a lilac or neutral stain. It constitutes about two-thirds of all the white cells in normal blood and is easily recognized.

Eosinophile.—This cell is slightly larger than the preceding, but of the same general shape. They are easily recognized by the coarse granules in the cytoplasm which stain a brilliant pink, the result of their affinity for the acid or eosin stain. In normal blood they constitute about 2 per cent of all the leukocytes and are easily recognized.

Basophiles.—This cell is of approximately the same size as the eosinophile and of the same general shape. They are easily recognized by the irregular coarse granules in their cytoplasm which stain a deep violet blue, the result of their affinity for the basic stain. In normal blood they constitute about one-fourth to one-half per cent of the total leukocytes and are easily recognized.

Describe the blood platelets. The blood platelets are disk-shaped bodies which appear in blood as short rods or as circular or elliptical plates, much smaller than red-blood corpuscles. They are normally present in blood in the number of about 300,000 per cubic millimeter. They consist only of protoplasm with no nuclear material and do not contain hemoglobin; when stained with Wright's stain they are more purplish than blue, show thread-like projections, and to the untrained eye might be confused with malarial parasites when lying on a red cell. It is uncertain whether they are to be considered as independent cells or as fragments of cells, the latter, however, being the more generally accepted theory in which it is stated that they are pinched-off projections of the giant cells of the bone marrow. Their important function seems to be the part they take in the coagulation of the blood.

THE RESPIRATORY SYSTEM.

Of what does the respiratory apparatus consist? It consists of the larynx, trachea, bronchi, lungs, and pleuræ, and should include also the nasal chambers. While air is also admitted through the mouth and pharynx, these are not included under the description of the respiratory apparatus.

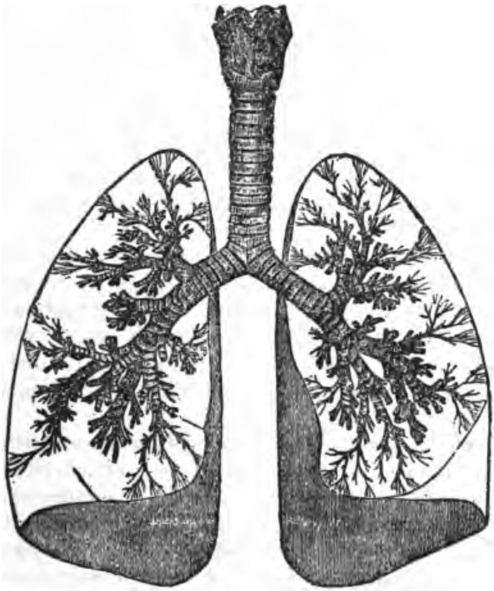


FIG. 21.—The larynx, trachea, right and left bronchi, and the lungs. The latter have been cut open to show the method of division and subdivision of the bronchi. (Mason.)

Describe the larynx. The larynx, or organ of voice, is situated at the upper and front part of the neck between the trachea and base of the tongue, and is composed of nine cartilages, which are connected together by ligaments. The largest of these cartilages is known as the thyroid cartilage, which forms a vertical projection in the middle line of the neck, and whose upper part constitutes the so-called Adam's apple. In the interior of the larynx are the vocal cords, true and false. In the act of swallowing the larynx is forcibly lifted, the base of the tongue descends, and the vocal cords approximate, thus preventing the food from entering the windpipe.

Describe the trachea or windpipe. The trachea or windpipe is a cartilaginous and membranous tube which extends downward about 4½ inches from the lower part of the larynx to its division opposite the fifth thoracic vertebra into the two bronchi, one for each lung. The cartilages of the trachea are arranged in rings, vary from 16 to 20 in number, rarely overlap each other, and serve the purpose of keeping the windpipe open. The trachea lies in front of the esophagus.

Describe the bronchi. The bronchi are two in number, the right and left, and each goes into the corresponding lung. The right bronchus is larger, shorter, and more vertical than the left, so that foreign bodies in the windpipe would be directed toward this bronchus. They divide into branches like a tree, and finally the smallest branches end in little sacs called air vesicles or alveoli; these air sacs are very numerous and go to make up the greater part of the lung substance.

Describe the lungs. There are two lungs, one on either side of the thoracic cavity; the right lung has three lobes, the left but two. There are two types of circulation in the lungs, the blood coming from the right ventricle through the pulmonary arteries to give off the CO_2 and receive a fresh supply of oxygen, and that coming from the bronchial branch of the aorta for the supply of the lung tissue itself.

What is the pleura? The pleura is a serous membrane lining the inner side of the thorax (parietal layer) and reflected over the outer surface of the lung, dipping into the fissures between its lobes (visceral layer). Each lung is enveloped in its own pleural sac, which do not communicate one with the other, and the space between the layers, containing a very little clear fluid, is the so-called pleural cavity; in health the two layers are in contact and there is no real cavity. The region left between the separate pleuræ contains all the thoracic viscera except the lungs, and is named the mediastinum.

Explain the act of respiration. The cycle of respiration is divided into three stages: (1) Inspiration, or flow of air into the lungs; (2) expiration, or forcing of air out of the lungs;

and (3) a period of rest. This cycle is completed about 18 times per minute in the normal adult while at rest. The chest cavity is therefore enlarged and an inspiration produced in two ways, namely, by a contraction of the diaphragm and by an elevation of the ribs. These two acts cause an enlargement of the thoracic cavity, the lungs expand accordingly, and the pressure of the outside air being greater than that inside the air

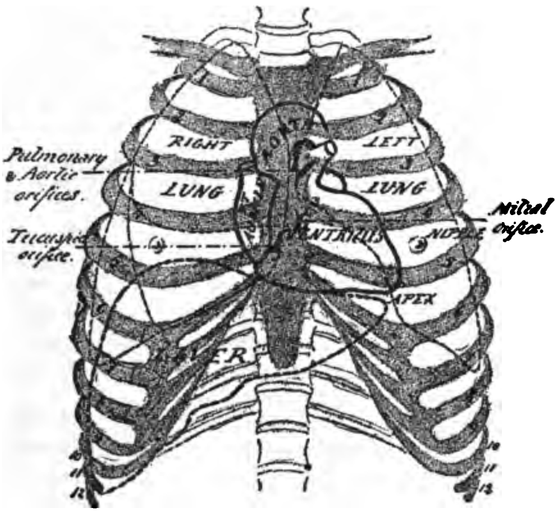


Fig. 22.—Outline of heart, lungs, and liver, showing their relations to each other and to the chest wall. (Hensman and Fisher.)

rushes in and equalizes this pressure. Those muscles which cause an elevation of the ribs are classed as inspiratory muscles. Expiration is produced by a diminution in size of the thorax and is brought about in two ways—first, by contraction of the abdominal muscles, which forces the diaphragm farther into the thoracic cavity, provided the upper respiratory tract is open; and, second, by the action of certain muscles which depress the ribs.

Describe the aeration of the blood. In passing into the lungs the inspired air loses a certain volume of oxygen and gains a certain volume of carbon dioxid, and it is the aeration of the blood that is directly responsible for this. In order to understand this one must appreciate two facts, namely, that gases diffuse from a point of high tension to one of lower tension, and that the actual pressure of the oxygen in the venous blood is much less than it is in the alveolar air, while the tension of the carbon dioxid is greater. It is definitely known that the larger part of the oxygen is held in loose chemical combination with the hemoglobin of the red blood corpuscles as oxyhemoglobin, and less loosely combined with a different constituent of the hemoglobin is a large percentage of the carbon dioxid in the form of carbohemoglobin. The impure blood is brought to the lungs by the pulmonary arteries and passes into thousands of little capillaries that surround the air vesicles. This leaves the impure blood in the capillaries separated from the air in the vesicles by only a very thin membrane. This membrane therefore separates gases at different pressures, and it is a well-known fact that under these conditions the molecules of each gas will pass through the membrane from the point of high tension to low tension and in both directions (osmosis) until the pressure is equal on both sides. The blood thus purified is collected in the capillaries which converge to form several veins which further unite to form larger veins and finally the pulmonary veins, and is returned to the left auricle of the heart for general circulation.

What is the difference between inspired and expired air? Expired air contains a higher percentage of carbon dioxid, a lower percentage of oxygen, and an increase in moisture.

THE DIGESTIVE SYSTEM.

(NOTE.—Foods are discussed under the heading "Foods" in the chapter on hygiene and sanitation, and should be carefully studied before proceeding with a study of the digestive system.)

What is meant by the term digestion? Digestion is that process by which various foods are taken into the body, then

broken up into simpler structure and absorbed by the system for the purpose of feeding the body tissues.

What are the component parts of the digestive tract? Mouth, pharynx, esophagus, stomach, small intestines, and large intestines terminating in the anus. We should rightfully include in this the liver, pancreas, and the salivary glands, which we call accessory organs, and the teeth and tongue which might be termed associate organs.

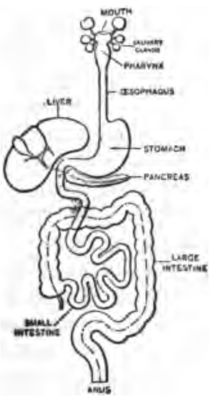


FIG. 23.—Diagram of the alimentary tube and its appendages. (Testut.)

What is an enzyme? It is the general name given to the substances (unorganized ferments) that bring about the changes that food undergoes in the process of digestion. Each enzyme has a specific action and is in practically all cases designated by the termination "in" or "ase," as pepsin, maltase, etc.

What part of digestion takes place in the mouth? Mastication and insalivation. The former is accomplished by the teeth dividing the food into small particles; the latter is the mixing of food with saliva.

What is saliva? The saliva as found in the mouth is a colorless or opalescent, viscid liquid of weakly alkaline reaction. It is the first secretion with which the food comes in contact and is a mixed secretion from the salivary glands. There are three salivary glands on each side that pour their secretions through ducts into the mouth, and as their names suggest lie as follows: The parotid in front of the ear, the submaxillary under the lower jaw, and the sublingual under the tongue. The saliva contains a ferment known as ptyalin, which acts upon the carbohydrates (starches) forming maltose and a form of dextrin; these are then acted upon by another ferment found in the saliva known as maltase converting them into the simple sugar, dextrose.

How many permanent teeth are there in the mouth? There are 32 permanent teeth, 16 in each jaw; 4 incisors (2 central and 2 lateral), 2 canines (cuspids), 4 bicuspids, and 6 molars. The last molars are also known as the wisdom teeth.

FIG. 24.—Right half of upper jaw (from below), with the corresponding teeth. The letters and numbers point to the classes of teeth and the numbers in classes. (Gray.)

What is deglutition? Deglutition, or swallowing, is the act of transferring the food from the mouth to the stomach. In its passage the bolus of food passes into the pharynx, then into the esophagus, and finally into the cardiac opening of the stomach.

Describe the pharynx. A musculo-membranous tube at the back of the mouth and nose and the upper part of the esophagus whose cavity is subdivided into that part which lies above the soft palate, known as the nasopharynx and into which opens the posterior nares and the eustachian tubes, that part which extends from the soft palate to about the level of the hyoid bone which communicates with the mouth through the fauces known as the oropharynx and in whose lateral walls we find the tonsils, and that part which lies behind the larynx known as the laryngopharynx which communicates with the esophagus.

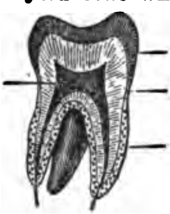


FIG. 25.—Vertical section of molar tooth. (Gray.)

Describe the esophagus. This is commonly called the gullet and is a muscular tube, about 10 inches in length, extending from the pharynx to the stomach. It is situated practically in

the median line, inclining slightly to the left in places, rests upon the vertebral column, and about half an inch before its termination pierces the diaphragm. No digestion takes place in the esophagus.

Describe the stomach. The stomach is a hollow organ about 13 inches long, 3½ inches wide, and 5 inches deep, and has a capacity in the adult of about 5 pints. The opening by which it communicates with the esophagus is known as the esophageal or cardiac orifice, while that opening by which it communicates with the intestines is known as the duodenal or pyloric orifice. It also presents two curvatures, the l e s s e r, which is the continuation of the right margin of the esophagus, and a greater curvature, which forms the lower convex surface. It has three coats—the external or serous coat, the middle or muscular coat, and the internal or mucous coat. The latter is arranged in many folds and contains numerous glands for the secretion of gastric juice.

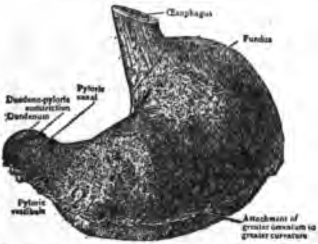


FIG. 26.—The stomach. (Cunningham.)

Describe the gastric juice and the gastric digestion. The gastric juice is a thin, colorless, or nearly colorless liquid with a strongly acid reaction. It contains hydrochloric acid and three ferments—pepsin, rennin, and lipase. The acidity is due to hydrochloric acid, and is usually estimated at 0.3 per cent, but during digestion may reach 0.4 to 0.5 per cent. When the food reaches the stomach it meets the gastric juice, which, for the most part, is sufficiently acid to destroy the ptyalin, except that part which may remain in the fundic end of the stomach for an hour or more untouched by the acid secretion, and where, therefore, the ferments of the mouth continue to act for a variable time. The food is churned about in the stomach and mixed with the gastric juice; here the pepsin acts on the pro-

tein, having the peculiarity of acting only in an acid medium, with the result that it splits the complex protein molecule into a much simpler structure. The action of rennin is confined to milk, curdling the chief protein constituent of milk—casein—the further digestion of it being carried on by the pepsin. The lipase in the stomach is supposed to act on those fats which are ingested in emulsified form, as in milk, partially saponifying them. Stomach digestion is completed in from three to five hours, and the contents, called chyme, are then periodically forced through the pyloric opening into the small intestine.

Describe the intestine. The intestine is a musculo-mucous tube about 28 feet long, beginning at the pyloric orifice of the stomach and ending in the anus. It is divided into the large and the small intestine. The latter is about 22 feet in length and is divided into three parts, the first being the duodenum, which is about 12 inches in length, the second the jejunum, 9 feet in length, and the third the ilium, which is about 13 feet in length. The small intestine is made up of three coats, the outer or serous coat made up of the peritoneum, the middle or muscular coat, and the inner or mucous coat. The mucous coat is arranged in little elevations called villi, and inside these villi are small capillaries which absorb directly the products of digestion, and a large lymphatic capillary or lacteal (occasionally several) that collects the properly digested foods and transmits them to the general circulation through the thoracic duct. There are numerous glands found in the mucous coat of the small intestine that manufacture and secrete the intestinal juice. The intestine has a vermicular sort of motion, due to its muscular coat, which is called peristalsis, thus causing a gradual

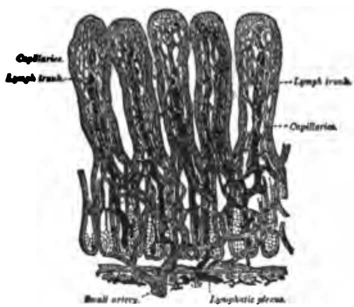


FIG. 27.—Villi of small intestine. (Cadiat.)

movement onward of the food and a thorough mixing of the food with the digestive juices. The large intestine is about 6 feet long and is divided into the following parts: The cecum, ascending colon, the transverse colon, the descending colon, the sigmoid flexure, and the rectum. The appendix is a small outshoot from the lower end and back of the cecum. The large intestine has the same number of coats as the small intestine, arranged in the same order; it is larger in lumen, and its surface is lubricated by a secretion from its glands. At the entrance of the small into the large intestine is a valve made up of mucous membrane called the ileocecal valve; it prevents the regurgitation of food into the small intestine. The rectum acts as a storage place for the unused portion of the food, it being expelled from the rectum at intervals in the voluntary act of defecation.

Describe the intestinal juice. This is derived from certain glands which are situated in the walls of the small intestine and contains four or five different enzymes, one of the most important groups being the inverting enzymes which convert one form of sugar into another. There are three of these—maltase, which acts upon maltose and dextrin, taking up (as seen later) the unfinished work of the pancreatic juice; invertin, which acts upon cane sugar; and lactase, which acts upon milk sugar, converting these sugars into dextrose preparatory to absorption.

What other secretions are emptied into the intestine that assist in the digestion of food? The pancreatic juice and the bile.

Describe the pancreas. The pancreas is a gland about 6 inches long, three-fourths of an inch broad, and one-quarter of an inch thick, situated behind the stomach at about the level of the second lumbar vertebra. It has a head, body, and tail, the former being surrounded by the duodenum. The duct of this gland empties into the duodenum a fluid known as the pancreatic juice.

Describe the pancreatic juice. This is an alkaline liquid which is thin and limpid. The secretion is started as soon as the chyme passes through the pylorus. The digestive action

of the secretion depends upon the three enzymes—trypsin, amylopsin (amylase), and steapsin (lipase). The trypsin acts upon the proteins and splits them into simpler forms and many into their end products ready for absorption. Amylopsin acts upon the starches with the production of maltose and a form of dextrin; steapsin acts upon the fats, breaking them up into glycerin and fatty acids.

Describe the liver. The liver is a large organ situated in the upper right side of the abdomen, directly under the diaphragm, and held in this position by ligaments formed of the peritoneum. It is supplied with blood from two independent sources—the hepatic artery and the portal vein, that supplied by the artery being only for the connective tissue framework of the organ. The portal vein enters the liver in the same fissure that the hepatic artery enters (transverse fissure) and brings to the liver the blood collected from the capillaries of the organs of digestion and absorption, and these soluble products are submitted to the action of the liver cells before reaching the general circulation. This blood finally makes its exit from the liver as the hepatic veins which empty into the inferior vena cava. The liver has five lobes and five fissures, and in one of these fissures on the under-surface of the right lobe of the liver there is lodged the gall-bladder, a pear-shaped organ 3 or 4 inches in length, with a capacity of 30 to 40 milliliters, and whose function is to serve as a reservoir for bile. The functions of the liver are to manufacture bile, to manufacture and store glycogen as well as to reconvert this to dextrose, if such be necessary, by the action of an enzyme in the liver, and to form urea.

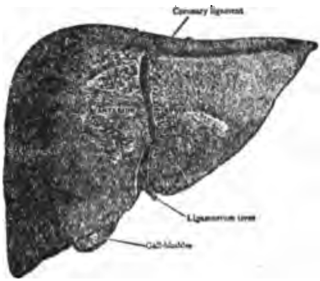


FIG. 28.—The liver. (Cunningham.)

Describe the bile. Bile is partly an excretion carrying off certain waste products and partly a digestive secretion. It

is manufactured in the liver and passes out of the liver through two main ducts which unite to form the hepatic duct. This duct is joined by the cystic duct from the gallbladder to form the common bile duct which opens into the duodenum. The bile is formed more or less continuously and enters the duodenum periodically during the time of digestion. It is prevented from entering at other times by the closing of the opening of the common bile duct into the intestine, which results in the secretion being dammed back in the gallbladder. Bile is a golden-yellow or dark-olive colored fluid, feebly alkaline, and secreted normally in amounts varying from 500 to 800 milliliters in 24 hours. As an excretion bile removes from the body certain waste products of metabolism, as disintegrated cells, bile pigments, etc. As a digestive secretion its most important function is the part it takes in splitting up the fats and in the absorption of these products. Its presence in the intestine, while not exerting any direct antiseptic action, nevertheless limits in some way the extent of putrefaction.

Where and how does absorption from the digestive tract take place? While there may be, and undoubtedly is, some absorption in the stomach, this does not occur readily, the greater part of absorption taking place in the small intestines. This takes place by two paths—the products of digestion may enter the blood directly by passing into the capillaries of the villi, or they may enter the lacteals of the villi, pass into the lymph circulation, and through the thoracic duct of the lymphatic system, eventually reaching the blood vascular system. The digested fats are absorbed by way of the lacteals, but the other products of digestion are absorbed mainly through the blood vessels and therefore enter the portal system and pass through the liver before reaching the circulation. Carbohydrate food is absorbed for the most part as simple sugars. Little, if any, absorption of sugar takes place in the stomach. The bulk of our carbohydrate food is taken in the form of starch; the resulting dextrose enters the portal vein and is distributed first to the liver, and in this organ the excess of sugar

is withdrawn from the blood and stored as glycogen, so that the amount of sugar in the general circulation is constant.

Absorption of fats.—The popular belief at present is that the fat is first split into fatty acids and glycerin and is absorbed by the epithelial cells in these forms. The bile, as well as the pancreatic juice, plays an important part in the absorption of fats, the bile furnishing certain bile salts (glycocholate and taurocholate of sodium) which aid the lipase in splitting the neutral fats and furthermore dissolve the fatty acids, bringing them into contact in soluble form with the epithelial cells. The fat after passing through the epithelial lining and entering the villi is taken up by the lacteals, where it is known as chyle, which is fat in the form of an extremely fine emulsion. In this form it is carried to the thoracic duct and thence to the venous circulation. A small amount of the fat is absorbed directly by the blood vessels of the villi and goes through the liver, that organ holding back some of it for its own use.

The digested protein is absorbed by the blood vessels of the villi, but the exact form in which it is absorbed and circulates in the blood is not satisfactorily determined. The most probable theory is that the proteins are broken down during digestion to amino bodies, the so-called building stone of the protein molecule; they are absorbed as such and carried to the tissues, where they are stored and subsequently used as necessary.

There are no enzymes in the large intestine, but when the contents of the small intestine pass the ileocecal valve they still contain a certain amount of unabsorbed food material and this is absorbed in the large intestine. There is a marked absorption of water in the large intestine, and it is this rapid loss of water that gives the consistence of the feces which the latter have acquired by the time they reach the descending colon.

What is the peritoneum? The peritoneum is a serous membrane covering the inner wall of the abdomen and reflected on the various organs contained therein. It completely covers some of the organs and only partially covers the remainder. It is lubricated by the peritoneal fluid, thus making a smooth surface for the free movement of the intestines. Parts of the

duodenum, the colon, and the kidneys are not covered by peritoneum; the remaining principal organs are completely surrounded by this membrane. Numerous folds of the peritoneum extend between the various organs or serve to connect them with the walls of the abdomen; some of these are the various ligaments, as of the liver, the mesentery, which connects the intestine with the posterior abdominal wall, the omentum, which extends from the stomach to certain organs in the abdomen, etc.

Into what divisions is the abdomen divided for the purpose of description? It is divided into nine regions by dropping a perpendicular line from the junction of the eighth costal cartilage with its rib on either side; this divides the abdomen into three sections. A horizontal line is now drawn at the level of the crests of the ilium and a second horizontal line at the level of the ninth costochondral articulation.

FIG. 29.—The regions of the abdomen and their contents. Edges of costal cartilages in dotted outline. (Gray.)

The nine regions are called, from above downward, right and left hypochondriac, with the epigastric in the middle; then the right and left lumbar and umbilical in the center; and the right and left inguinal with the hypogastric in the center.

THE LYMPHATIC SYSTEM AND DUCTLESS GLANDS.

Of what is the lymphatic system composed? It is composed of small glands, usually found in bunches, known as lymph nodes or lymphatic glands, lymph vessels, and lymph. These are arranged into a superficial set placed immediately beneath the skin and a deep set which accompany the deep blood vessels.

They are very numerous, being found in nearly every tissue and organ of the body which contains blood vessels and are named for the most part from the region in which they are situated; some of the most important of the lymph glands are the axillary, inguinal, anterior and posterior cervical, mesenteric, etc. Besides the nodes the body contains numerous structures which, in construction and function, are allied to lymph nodes and are spoken of as lymphoid tissue, as the tonsils and spleen.

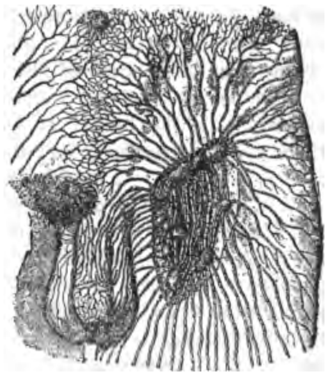


FIG. 30.—Nodes of the inguinal region with the afferent and some of the efferent lymphatics. (Poirier and Charpy.)

Describe the lymph. Lymph is, in most parts of the body, a transparent, colorless, or slightly yellow fluid, more dilute than blood plasma, and circulates in a lymph vascular system in only one direction—toward the heart. It is scantily supplied with corpuscles, known as lymphatic corpuscles, which are identical with the leukocytes of blood, being for the most part small lymphocytes. In the lymphatic vessels of the intestine during absorption fat globules are so abundant as to impart a milky-white color to the lymph, termed "chyle." Lymph is derived from the plasma of blood mainly by filtration through the capillary walls, and is also formed by absorption, as in the alimentary tract. The function of the lymph is principally to feed the tissues and remove waste material. The lymph is conveyed by the lymphatic vessels to two main lymph channels, the thoracic duct and the right lymphatic duct.

Describe the thoracic duct. The thoracic duct is 15 to 18 inches long and extends from the second lumbar vertebra to the root of the neck, lying just in front of the vertebræ; into it

empty all the lymphatic vessels of the body, except those that empty into the right lymphatic duct. It empties into the vein where the left subclavian and left internal jugular veins join.

Describe the right lymphatic duct. It is about half an inch in length and lies at the root of the neck along the inner border of a muscle known as the scalenus anticus and terminates at the junction of the right subclavian and internal jugular veins. It receives the lymph from the right side of the head and neck, right upper extremity, right lung, right side of heart, and part of the convex surface of the liver.

Describe the spleen. This is the largest organ of lymph structure in the body. It is situated principally in the left hypochondriac region, is bean-shaped, and measures about 5 inches in length. It is of a dark purplish color, highly vascular, soft, of very friable consistence, and has no duct leading from it. Its functions are not definitely proven, but it is supposed to be concerned in the production of lymphocytes and in the preparation of new hemoglobin by preserving the iron set free as a result of the destruction of senile red blood corpuscles. It has been thought that it was an organ for the destruction of red blood corpuscles, but this theory has not been satisfactorily demonstrated.

What are ductless glands? These are glands the products of which are filtered directly into the blood or lymph without the intervention of a duct. The principal ones are the thyroid gland, thymus gland, suprarenal glands, and pituitary body. To these secretory products the name internal secretion has been given, but it has been demonstrated that this is a function possessed also by some of the typical glands provided with ducts, as the pancreas, etc.

Describe the thyroid gland. This is a highly vascular organ situated on the sides of the trachea at its junction with the larynx and extending upward on each side of the larynx. It consists of two lateral lobes connected across the middle line by a narrow transverse portion known as the isthmus. On or near the posterior surface of the thyroid are found four small glandular bodies known as the parathyroid glands. The func-

tion of the parathyroid seems to consist in furnishing an internal secretion which neutralizes in some way toxic substances which are formed elsewhere in the body, and, therefore, when the secretion is totally absent death results from the accumulation within the blood and tissues of such toxic agents. The thyroids are supposed to form an internal secretion which stimulates other tissues, particularly those of the central nervous system.

Describe the thymus gland. This gland varies in size but at its maximum consists of two lateral lobes in close contact along the middle line of the body and extending from the level of the fourth costal cartilage upward as high as the lower border of the thyroid gland. It continues to increase in size after birth until the age of puberty, when it loses slowly in weight and never completely disappears, though greatly atrophied in old age. Its function is obscure, but it is believed that through its internal secretion it influences the growth of the body and the development of the reproductive organs.

Describe the suprarenal glands. These are two irregular, flattened masses situated at the back part of the abdomen, behind the peritoneum, and immediately above and in front of each kidney. Their average size is 2 inches in length, about the same in width, and one-quarter of an inch in thickness. They are also known as the adrenal bodies. The function of the suprarenals is in no wise connected with that of the kidneys. A part of its internal secretion, from the internal part of the gland, under the name of epinephrin, passes into the blood and exerts a marked stimulating effect upon the tone of the blood vessels and upon the heart and perhaps upon the skeletal muscles, while that part secreted from the external part of the organ (cortex) is believed to furnish a secretion which neutralizes certain toxins in the body which retard tissue growth.

Describe the pituitary body. This is a small gland situated in the floor of the third ventricle of the brain, and is composed of an anterior and posterior lobe which subserve different functions. The internal secretion of the anterior lobe is connected, for one thing, with the process of growth, particularly of the

skeleton, while that from the posterior lobe exerts a specific effect on the organs of circulation and the kidneys and stimulates the activity of the mammary glands.

THE EXCRETORY APPARATUS.

What organs are to be considered as instrumental in eliminating the waste products of the body? The lungs, rectum, skin, and kidneys.

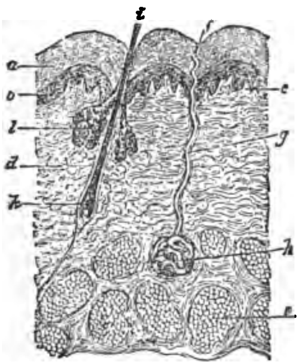


Fig. 31.—Perpendicular section of the skin, showing: *a*, The epidermis, cuticle, or scarf skin; *b*, layer of dark-colored cells; *c*, the papillae on the surface of *d*, the corium, derma, cutis vera, or true skin, and *e*, the fat cells underlying it; *f*, a perspiratory pore or aperture; *g*, the duct, and *h*, the coiled substance of a sudoriparous gland; *i*, the shaft of a hair, *k*, its root, and *l*, sebaceous glands communicating with the interior of the hair follicle. (Mason.)

Describe the skin. The skin is a tough elastic membrane forming the outer covering of the body. It is made up of two principal layers—the derma or true skin and the epiderma or cuticle. The former is thick and supports the blood vessels, hair follicles, and sebaceous and sweat glands. The appendages of the skin are the hair and the nails, the latter being modified cuticle.

The sebaceous glands secrete an oily substance which keeps the skin soft and pliable.

The skin acts as an excretory organ through the sweat glands, which are found in vast numbers throughout the derma of the entire body. The glands empty their contents through orifices known as pores and excrete perspiration, which is made up of water and waste material. The functions of the skin, other than as an excretory organ, are to form a protective covering and to receive the specialized nerve endings which carry impressions of heat, cold, touch, and pain to the central nervous system.

Describe the kidneys. The kidneys are two in number; they are situated deep in the abdomen, behind the peritoneum, one on either side of the spinal column, and extend from the twelfth thoracic vertebra to the third lumbar vertebra, the right being slightly lower than the left. They are bean-shaped, and each kidney is about 4 inches long, 2 inches broad, and 1¼ inches thick. The kidney substance consists of an outer third, known as the cortex, and an inner two-thirds, known as the medulla. The cortex is formed of straight tubules for conveying the urine, convoluted tubules, and thousands of little structures known as the Malpighian bodies (renal corpuscles). These bodies are made up of a tuft of capillaries (glomerulus) which, as the result of development, have been sort of shoved into a double-layered membrane which invests the capillaries, except at one point where the small blood vessel enters and leaves the capillary tuft, and lined by epithelial cells, the inner layer being closely in contact with the capillaries. At a point opposite the entrance of the blood vessels the capsule is open and is continued as the first part of the convoluted tubules. The medulla is made up of tubules for conveying the urine, and these are continuous with those of the cortex. These collecting tubules converge to the inner border (hilum) of the kidney and finally end in the pelvis, which leads directly into the ureter. There are two theories regarding the manner in which the urine is secreted—the mechanical theory, in which it is supposed that the water filters directly from the glomeruli through the membrane of the corpuscle and carries with it the various constituents of the urine; and the other, known as the secretory theory, in which it is assumed that the cells lining the glomerulus through their secre-

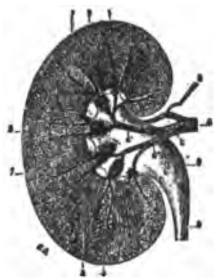


FIG. 32.—The kidney on section. (Guiteras.) 1. Capsule. 2. Pyramids of Malpighi. 3. Columns of Bertini. 4. Renal artery. 5. Same, its posterior branch. 6. Same, its anterior branch. 7. Peripyramidal arteries. 8. Renal pelvis. 9. Ureter.

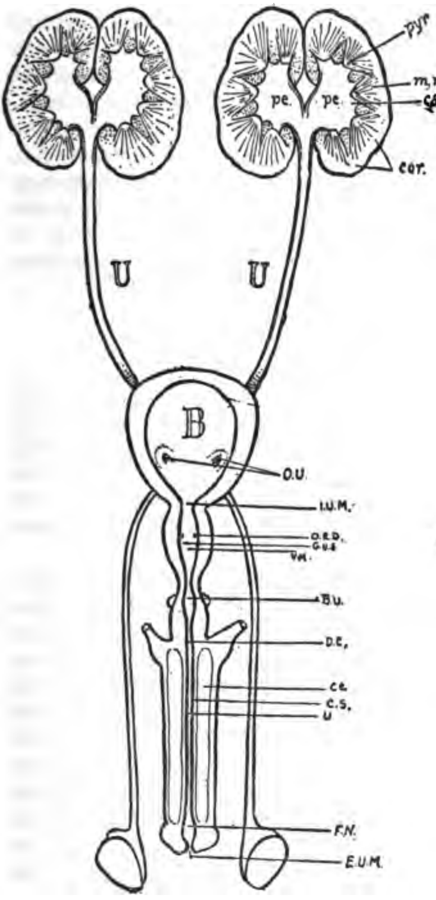
tion form the water and salts of the urine, while the cells which line the convoluted tubules form the organic constituents of the urine as urea. The latter theory is the one generally accepted.

The pelvis of the kidney is an open space into which the collecting tubules empty their contents; it is somewhat funnel-shaped, the spout of the funnel going to make up the beginning of the ureter.

Describe the urine. The urine is a light amber-colored fluid, acid in reaction, having a specific gravity of 1.015 to 1.025. There are about 1200 to 1500 milliliters excreted daily, and the principal solid constituent is urea; it also contains uric acid, urates, phosphates, carbonates, and chlorids, but never does normal urine contain albumin or sugar.

Describe the ureters. The ureters are two musculo-membranous tubes, about the size of a goose quill in diameter and about 15 inches long. They extend from the pelvis of the kidney to the lower and back part of the bladder, where they pierce this organ and deliver the excretion of the kidneys. When the ureters enter the bladder they take a course obliquely through the walls so that when the bladder is distended the coats of the ureters are approximated forming a sort of valve which prevents the urine regurgitating from the bladder.

Describe the bladder. The urinary bladder is a musculo-membranous sac situated in the pelvis, just behind the pubis, and does not under normal conditions extend above the height of the upper border of the symphysis pubis; when greatly distended it may extend as high as the umbilicus. It acts as a reservoir for the urine until it is convenient to discharge this fluid (micturition). In the undistended condition the bladder is covered by the peritoneum, except the anterior and part of its inferior surfaces. It is held in place by various ligaments which are derived partly from the peritoneum and partly from the tissues lining the pelvis. Upon the inner surface of the bladder the mucous membrane is thrown into folds (rugae), except over that area known as the vesical trigone, which is that triangular surface outlined by the three openings into the bladder, the entrance for each ureter and the orifice of the urethra.



pe. The pelvis of the kidney.
cor. The cortex, the part between the cortex and the pelvis being the medullary portion.
pyr. Pyramid.
ca. The calices.
m. r. The medullary rays.
U. The ureters.
B. The bladder.
o. u. The ureteral openings.
i. u. m. The internal urinary meatus.
o. e. d. The openings of the ejaculatory ducts in the prostatic urethra.
g. u. s. The genito-urinary sinus.
v. m. The veru montanum.
b. u. The bulbous urethra.
d. c. Openings of the ducts of Cowper's glands.
c. c. Corpus cavernosum.
c. s. Corpus spongiosum.
u. Urethra.
f. n. Fossa navicularis.
e. u. m. External urinary meatus.

FIG. 33.—Anterior view of the opened genito-urinary tract in the male. (Guiteras.)

Describe the urethra. The urethra is a membranous tube passing from the bladder along the under surface of the penis to the distal end of that organ where it terminates in the meatus. It is about 8 inches long and is divided into three parts, the first being the prostatic part, which is surrounded by the prostate gland, the second is called the membranous portion and is surrounded by the constrictor urethræ muscle, which prevents the escape of the urine until convenient for the individual, and the third, or penile portion, is that part found on the under surface of the penis. The external orifice of the urethra is known as the urinary meatus. Into the prostatic urethra there empty the ejaculatory and the prostatic ducts.

THE NERVOUS SYSTEM.

Of what is the nervous system made up? The central nervous system includes the brain and spinal cord, the peripheral nervous system or the nerves coming off from the brain or spinal cord, which are ultimately distributed to the special organs or the muscles and skin, and, lastly, the sympathetic nervous system, which acts principally on the involuntary muscular tissues of the body.

Describe the brain. The brain is contained within the cranium and may be divided into four parts—(1) the cerebrum, (2) the cerebellum, (3) the pons varolii, and (4) the medulla oblongata. The brain is surrounded and protected by membranes called the meninges, and the same is true of the spinal cord. The cerebrum is divided almost completely into two halves (hemispheres) by a longitudinal fissure, the area which joins the two hemispheres in the depths of the fissure being known as the corpus callosum; the surface of each hemisphere presents many fissures and convolutions, which, while subject to some variation, are more or less constant. Some of these fissures can be easily demonstrated, as the lateral fissure, or the fissure of Sylvius, which is a well-marked fissure on the base and external surface of each hemisphere; the central fissure, or fissure of Rolando, which is situated at the middle of the convex

surface of each hemisphere and extends laterally and slightly forward to within a short distance of the Sylvian fissure; and the occipital fissure, which shows as a deep cleft on the posterior part of the convex surface of each hemisphere. These fissures divide the cerebral surface into certain lobes. The frontal lobe, or that part anterior to the central fissure and above the Sylvian fissure, is the seat for the higher psychical thought, and the posterior part of this, just anterior to the central fis-

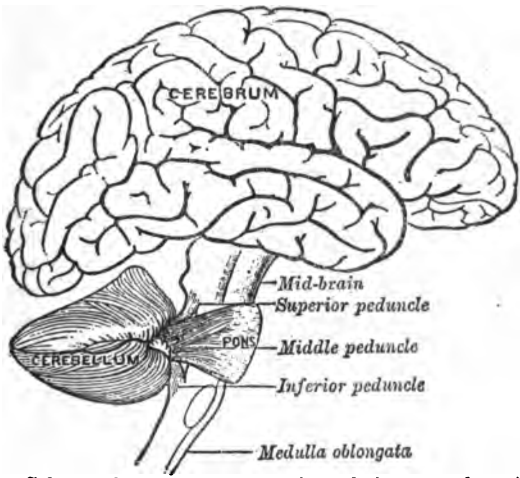


FIG. 34.—Scheme showing the connection of the several parts of the brain. (Gray.)

sure, lodges the centers which control motion, and is therefore known as the motor area; the parietal lobe, or that part posterior to the central fissure, anterior to the occipital fissure, and above the Sylvian fissure, lodges in its anterior part, just posterior to the central fissure, the centers which are concerned with such sensations as pressure, temperature, muscular sense, etc.; the temporal lobe, or that part below the Sylvian fissure, lodges the center for hearing; the occipital lobe, or that part

posterior to the occipital fissure and imperfectly defined, lodges the center for vision.

FIG. 35.—Spinal cord and nerves. (Mason.)

The cerebellum is below the posterior half of the cerebrum and is overlapped by the occipital lobes of the cerebrum. It has as its function, in part at least, that of regulating voluntary movements, particularly with reference to equilibrium and locomotion. The medulla oblongata is the continuation of the spinal cord on its way to the brain, and is the seat of those important centers which control the activity of the respiratory and circulatory organs. The pons varolii is located below the cerebrum and in front of the medulla and cerebellum and is the pathway for motor and sensory fibers. The substance of the brain is divided into white and gray matter, the latter being external to the white matter and composed chiefly of nerve cells. In the interior of the brain we find a number of cavities known as ventricles. One side of the brain to a great extent controls the opposite side of the body, as the fibers transmitting the impulses cross to the opposite side, chiefly in the medulla, before arriving at the scene of action.

Describe the spinal cord. The spinal cord is about 18 inches long and extends from the first cervical to the second lumbar

vertebra. It is surrounded by the meninges and is contained within the bony canal formed by the arches of the bones of the vertebral column. It is formed of white and gray matter, the latter being internal and the former external. It gives off 31 pairs of spinal nerves, each containing sensory and motor fibers. These nerves go to form the greater part of the motor and sensory peripheral nervous system, either through separate nerve trunks or via certain plexuses, such as the brachial, cervical, and lumbar plexuses.

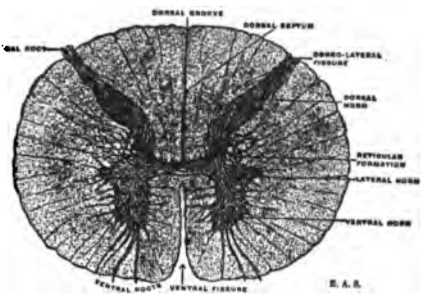


FIG. 36.—Trans-section of the spinal cord at the midthoracic region. (Gray.)

Name the cranial nerves and explain why they are called such. There are 12 pairs of cranial nerves named and numbered in the following order: (1) Olfactory, (2) optic, (3) motor oculi, (4) patheticus, (5) trifacial, (6) abducens, (7) facial, (2) auditory, (9) glossopharyngeal, (10) pneumogastric, (11) spinal accessory, (12) hypoglossal. They are called cranial nerves because they come off directly from the brain and pass through several foramina at the base of the skull.

Which of the cranial nerves are connected with the special senses? The first or olfactory is distributed to the nose and has to do with the sense of smell; the second or optic is the nerve of sight; the eighth or auditory is the nerve of hearing; and the ninth or glossopharyngeal, associated with branches from the fifth and seventh, presides over the sense of taste.

What is a nerve impulse? A nerve impulse is the name given to that movement or excitation which is set up in a nerve cell and conducted along its so-called fiber and is akin to electricity. All impulses originate in some kind of stimulus which may be mechanical, thermal, chemical, etc., the stimulus being con-

verted into an impulse and this in turn may further cause a cell stimulus which results in some evidence of activity as motion, secretion, etc., depending upon the nature of the tissue cells stimulated. The usually accepted view is that all nerve impulses are identical and the end result is explained by the manner of the ending of the nerve, as in muscle, in glands, in the brain, etc.

What do you mean by volitional movement? Volitional movement is that which is controlled by the brain by association of the several centers, causing a certain amount of thought before the movement is executed. For instance, an individual walking along the street suddenly comes to a puddle of water; by the aid of his sight he sees the water. This impression is immediately transferred to the thinking part of the brain, where the higher psychical centers, knowing that to walk through the water may bring about some ill effects, immediately inform the motor centers that certain movements must be made to carry the individual around the puddle. In this event walking, which is ordinarily a reflex action, becomes volitional action.

The distinction between voluntary movements and pure reflex acts is perhaps a mere matter of convenience, as the origin of the impulses in the brain cells is only apparent, there being always some stimulus from other neurons which causes the impulse. It is in those cases where manifestation of consciousness is pronounced that the distinction serves its best purpose, but there are many acts which it is difficult, if not impossible, to classify.

What is reflex action? A reflex action is one that is performed without the intervention of the higher psychic powers and may be exemplified by breathing.

What is the sympathetic nervous system? The sympathetic nervous system consists (1) of small ganglia (small bunches of nerve cells) connected by fine nerve fibers extending from the base of the skull to the tip of the coccyx and situated on each side of the vertebral column, and (2) of three collections of nerves and ganglia (plexuses) situated in the thoracic and

pelvic regions and known, respectively, as the cardiac, solar, and hypogastric plexus. The sympathetic system is connected with the cerebrospinal system by means of communicating nerves and has for its principal function the supply of the involuntary muscles of the body, chiefly those of the blood vessels, intestines, and general glandular system.

THE SPECIAL SENSES.

Describe the eye. The eyeball, or organ of sight, is contained within the bony orbital cavity of the face where it is securely protected from injury; it is additionally protected in front by the eyelids and lashes. It is embedded in fat but is partly surrounded by a thin membrane which suspends it in such a manner as to allow very free motion. In general shape the eyeball is composed of the segments of two spheres of different sizes, the anterior being a segment of a small sphere forming about one-sixth of the eyeball, and the posterior being a segment of a much larger sphere and forming about five-sixths of the globe. The eyeball is composed of three refracting media, the aqueous humor, the vitreous humor, and the crystalline lens, and three investing membranes, (1) the cornea and sclera, (2) the choroid, ciliary body, and iris, (3) the retina.

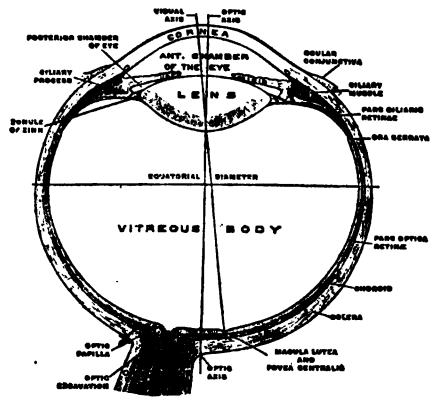


FIG. 37.—The right eye in horizontal section. (Toldt.)

Describe the cornea and sclera. These form the external membrane of the eyeball, the sclera being opaque and covering the

posterior five-sixths of the eyeball while the cornea is transparent and covers the anterior one-sixth. Reflected over the cornea and a small part of the sclera is a mucous membrane known as the conjunctiva which also lines the inner surface of the eyelids.

Describe the choroid, ciliary body, and iris. In the order given these form the middle membrane of the eye from behind forward, which has for its main function the nourishment of the nervous portion of the eye. The choroid consists of a dense network of blood vessels lining the posterior five-sixths of the globe and is connected to the circumference of the iris by the ciliary body, which is in reality formed by the processes of the choroid. The iris is a muscular diaphragm which dilates or contracts to allow a sufficient amount of light into the eye in order that a clear picture may be received on the retina. It contains a certain amount of pigment giving the blue, brown, or gray color, as the case may be.

Describe the retina. The retina forms the internal membrane of the eyeball, being continuous behind with the optic nerve and extending in front nearly as far as the ciliary body, where it terminates over the back of the ciliary process and iris. The retina is the expansion of the optic nerve which enters the eyeball at the inner side of the posterior pole. The retina is a very complex structure and consists of many layers (ten) of nervous tissue. Objects of the outer world throw their images upon the retina and it is the function of the retina to convert the rays of light of which the images are composed into nervous stimuli which are characterized as a series of nervous impulses in the optic nerve fibers. The general area for vision is in the occipital lobe of the brain.

Describe the lens. The crystalline lens is a biconvex, transparent body and is inclosed in a capsule to which is attached a ligament known as the suspensory ligament of the lens; this ligament retains the lens in position and is relaxed by certain muscles when it is necessary to increase the convexity of the lens in order to bring the proper focus of an object on the retina.

Describe the aqueous humor. This is a fluid closely allied to lymph which occupies the aqueous chambers of the eye, that space which is bounded in front by the cornea and behind by the lens, suspensory ligament, and ciliary body. The iris divides this chamber into a part anterior, known as the anterior chamber, and a part posterior, known as the posterior chamber, which communicate with one another.

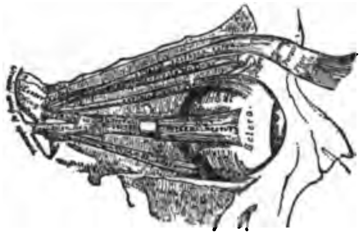


FIG. 38.—Muscles of the right orbit. (Gray.)

Describe the vitreous humor. This is a soft, transparent, jelly-like mass which fills the entire cavity back of the lens and suspensory ligament.

Describe the lacrimal apparatus. This consists of the lacrimal glands which secrete the tears and their ducts (6 to 12) which convey the fluid to the eye, from whence it finds its way into the nasal duct and into the cavity of the nose.

How is the eyeball moved? By six muscles, called the external, internal, superior, and inferior recti, and the superior and inferior oblique. These muscles allow the eye simply to rotate about a center of movement which corresponds approximately to the center of the eye. When we look with both eyes the muscles of one eye work with those of the other.

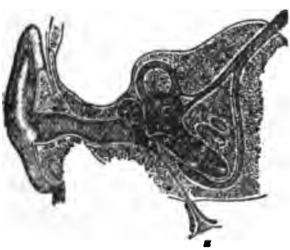


FIG. 39.—Section through right external, middle, and internal ear. (Howell.)

Describe the ear. The ear is the organ of hearing, and for purposes of description is divided into three parts—the external, middle, and internal ear.

The external ear is made up of the auricle, which collects the sound waves, and the external auditory canal.

The middle ear is a cavity in the temporal bone. It contains three small ear bones, arranged in series, one of which rests

against the eardrum, which is stretched across the opening to the external canal.

The internal ear contains the perceptive organ of hearing. Hearing is accomplished by sound waves striking against the eardrum and then being transmitted through the series of ear bones, which in turn cause vibrations in the internal ear which act on the nerve endings of the auditory nerve, and the impression is then transferred to the perceptive centers of hearing in the brain.

Explain the sense of smell. The nerve endings of the olfactory nerve are distributed to the mucous membrane of the nose, and small particles of certain kinds of matter coming in contact with these nerve endings cause impressions to be carried to the perceptive centers of smell in the brain.

Explain the sense of taste. There are certain organs situated in the epithelium of the tongue and adjacent parts known as taste buds, which are believed to act as the peripheral organs of taste. Around these taste buds terminate the fibers of those special nerves concerned in the transmission of taste. The most sensitive regions of the tongue are the tip, borders, and posterior portion of the dorsum. The special nerves of taste are a branch (chorda tympani) from the facial which joins with a branch (lingual) from the trifacial and supplies the anterior two-thirds of the tongue, and the glossopharyngeal, which supplies the posterior one-third. The center for taste in the brain is assumed to be in that part known as the hippocampal convolution. There are four fundamental taste sensations, namely, sweet, bitter, acid, and salty, and all other tastes are combinations of these. In order that the taste of substances may be appreciated it is necessary that they be in solution.

Explain the voice and speech. The larynx contains two cords stretched across it from before backward, leaving a small slitlike opening between them. These cords are separated or brought together by muscles, depending on the pitch of tone required. When the air is forced out of the lungs through this narrow slit certain sounds are produced, and with the help of the pharynx, tongue, mouth, and cheeks articulate speech is accomplished.

CHAPTER 2.

FIRST-AID AND EMERGENCY SURGERY.

Define first-aid as applied to service conditions. First-aid includes measures employed in the immediate treatment of wounds, accidents, and emergencies incident to the service.

What measures are included? Resuscitation of the apparently drowned and those overcome by noxious or poisonous gases; the treatment of wounds (gunshot, shell, bayonet, and others received in the field, and such wounds as may be the result of accident or violence), burns, scalds, frostbite or freezing, sun or heat stroke, heat exhaustion, snake bite, and sting of insects; the control of hemorrhages; and the preparation of patients for transportation.

What are the steps in the resuscitation of the apparently drowned? Remove the water from the lungs; clear the air passages; restore breathing; remove wet clothing; stimulate by heat and friction.

How is water removed from the lungs? Remove the upper clothing, place the patient face down, protecting the face by means of a piece of the clothing; clasp your hands under his abdomen and raise him sufficiently to permit all water to run from the lungs and air passages.

How should the air passages be cleared? Turn the patient on his back, placing a roll of clothing under the shoulders; wipe out the mouth and nostrils; inspect the mouth for the presence of any foreign objects, as particles of food, false teeth, etc., and remove these if present; pull the tongue well forward and tie or hold it by means of a string or handkerchief.

How is artificial respiration applied? (Schäfer method.) After removing water from the lungs and clearing the air passages, place the patient on his abdomen with his face protected by clothing and turned to one side; kneel beside him, or, if preferred, astride of him, with your knees at his hips and facing toward his head, and place the palms of your hands on the small of the back, the base of the palms in line with the spinal column, thumbs extended toward the lower ribs, fingers extended slightly. First movement—Lean forward and gradually bring the weight of your body on your hands (this movement should take two or three seconds). Avoid roughness. Second movement—Release the pressure quickly. After two seconds repeat the same movements. The object is to simulate natural breathing and the movements should be regulated accordingly, 12 to 15 per minute; this should be kept up for two hours at least, or until natural breathing is restored.

FIG. 40.—Expiration; pressure on. (Keen.)

FIG. 41.—Inspiration; pressure off. (Keen.)

In what cases may artificial respiration be required? Those persons apparently drowned, asphyxiated by gases, fumes, or noxious vapors and anesthetics, electric shock, shock or collapse, freezing or exposure to extremes of heat or cold, cases of poisoning, etc.; in other words, in all cases in which breathing is temporarily suspended.

By what symptoms may we recognize the necessity for artificial respiration? Cyanosis (blueness of the skin and mem-

branes), suspension of respiration, or shallow breathing in some cases of poisoning.

How is stimulation applied after artificial respiration? If apparently drowned, remove wet clothing (in other cases loosen those parts of the clothing which would restrict the circulation or respiration, such as the neck, wrist, and waistbands, and remove shoes and stockings); wrap in warm blankets; apply friction by briskly rubbing the extremities toward the body; apply hot-water bottles, hot bricks, or hot sand bags to maintain or restore body heat, but do not apply these in such a way as to come into direct contact with the body; mustard plasters may be applied to the feet and wrists to stimulate the circulation; a hypodermic injection of strychnin sulphate, 1/30 gr., may also be given. The administration of stimulants by mouth should never be attempted until the patient has recovered consciousness and is able to swallow.

How should bites and stings of insects be treated? If a sting is embedded in the skin or membrane, it should be removed by squeezing the part gently; apply wet salt, ammonia water, or alcohol and follow with cold applications. Stings of various insects may cause illness, but are seldom fatal. In cases of stings by poisonous insects and bites by poisonous reptiles a tourniquet should be applied at once to prevent as far as possible the entrance of the poison into the circulation.

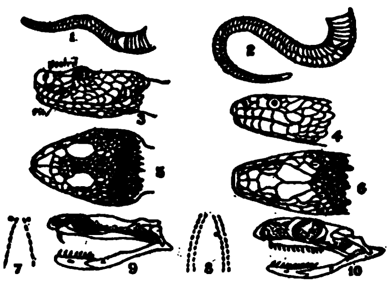


Fig. 42.—1, Single row of scales posterior to vent (poisonous snakes—water moccasin); 2, double row scales of harmless snake (Natrix); 3 and 5, side and dorsal view of head of pit viper; 4 and 6, side and dorsal view of head of harmless snake (Natrix); 7 and 9, bite puncture and skull of Elaps; 8 and 10, bite puncture and skull of harmless snake. (Stitt.)

What snakes may be poisonous? The poisonous snakes of North America, except the coral snake, belong to the pit-viper family, which includes

rattlesnakes, copperheads, and water moccasins. These snakes have a pit or depression between the eye and the nostril; the heads are heart-shaped and the bodies thick; the teeth are arranged in two rows, with a fang on each side outside the teeth near the front of the jaw. Fangs are characteristic of poisonous snakes. Nonpoisonous snakes have four rows of teeth without fangs.

What is the treatment of poisonous-snake bites? Ligate the limb above the wound; incise the wound freely with pocket or other knife; suck the wound; rub in potassium permanganate crystals. Do not give alcohol. At the end of half an hour, and from time to time afterward, loosen the tourniquet for a few seconds to prevent gangrene of the limb. Should the loosening of the tourniquet be followed by symptoms of marked depression, the tourniquet should be left in place and the danger of gangrene risked rather than death from the effects of the poison in the system.

What is the treatment of burns and scalds? Burns may be caused by flames, hot metals, caustics, or electric discharges; scalds are caused by hot liquids or steam; their effects are similar to burns. Minor burns of first degree may be treated by application of cloths saturated with a saturated solution of baking soda or normal salt solution. First-degree burns or scalds affecting all or nearly all of the body are fatal in most cases, and should be treated by wrapping the entire body in a greased sheet for the purpose of excluding air. In all cases of extensive burns there is shock, which may be severe and should be treated immediately, including where possible immersion of the entire body in warm normal salt solution until reaction occurs. Great care must be exercised in the removal of clothing from the burned areas. For burns of the second and third degree a solution of picric acid of 1 per cent strength should be kept in large quantities on hand at all times. Dressings wet with picric-acid solution or normal salt solution act both as antiseptics and as healing agents in second and third degree burns. The use of oils for dressings in serious burns is inadvisable for the reason that they, as a rule, are liable to be-

come rancid and acid in reaction, which causes them to be irritating, and also on account of the difficulty in keeping the parts clean and healthy when oils or greases are used on the dressings. Their great advantage is in the fact that they exclude air from the burned area, and this may be accomplished by properly applied wet dressings which are antiseptic and healing. The use of stronger antiseptics, such as phenol, corrosive sublimate, etc., in solution, should be avoided. If a burn is due to a mineral acid the area should be flushed with water followed by a wash of saturated solution of sodium carbonate. If caused by an alkali, flush freely with water, then with a dilute solution (1 in 4) of vinegar in water.

What is the treatment of sunstroke? Remove the patient to a cool, shady spot, out of doors. Remove the clothing, pour cold water over the body, and place ice bag at head to reduce the body temperature speedily. Cold water (not iced) internally in as large quantities as the patient may take should be given. Many serious after-effects result from sun or heat stroke, such as paralysis, insanity, persistent headaches, or simple mental confusion. The least exposure may result in death after recovery from an attack. The symptoms of sunstroke are headache, dizziness, redness of the eyeballs, dry skin, unconsciousness, labored breathing, and sometimes convulsions.

What is heat exhaustion? General functional depression due to heat, and is characterized by a cool, moist skin and collapse. Remove to a cool, dark, quiet place, loosen clothing, and, if conscious, give a dose (2 mils, well diluted) of aromatic spirit of ammonia. The patient should be kept on his back for several hours, rest and quiet assisting recovery.

What is the treatment for frostbite and freezing? The part affected should be rubbed with wet snow or with cloths wrung out from ice water until circulation of blood to the part is restored, which is evidenced by a returning redness of skin. Following this the temperature of the water should be gradually raised until it is of the body temperature. Too rapid and high an increase of temperature will have serious effects, so that great caution should be observed in the treatment of either

frostbitten or frozen members. The treatment should be carried out in a cold room, the temperature of which may be increased as the patient recovers. Cool or cold applications will relieve the pain, which is one of the usual after-effects.

What is the treatment for electric shock? Raise the head a little, draw the tongue forward, make artificial respiration, apply external heat, massage over the heart, and do not give alcoholic stimulants. Apply the stream of a warm douche to the head, rub the limbs with mustard, put a mustard plaster over the heart and another at the back of the neck. Wrap the patient in hot blankets, give enemata of hot saline fluid, and strychnin hypodermatically. Do not pronounce a person dead until a thorough attempt at resuscitation has been made. In removing a person from contact with live wires, etc., it must be remembered that the hands should never come in contact with the body of the patient. Rubber gloves, if available, should be worn, or the hands may be wrapped in dry cloths. The body of the patient should be carefully examined for injuries (burns, fractures, etc.) and these treated as soon as the patient sufficiently recovers from the effects of the shock.

What is the first-aid treatment for unconsciousness? Lay the patient supine on his back, loosen clothing at neck, wrist, and waistbands, give ammonia inhalations, enforce rest and quiet. The patient should be carefully examined to learn the cause. If convulsions are evident, protect the tongue by placing a rolled handkerchief or cork between the teeth. If due to alcoholic intoxication, the cause may be determined by the odor of the breath and appropriate treatment administered. In cases of poisoning emetics should be given immediately, and, if emetics are not available, tickling the epiglottis will usually be effective. The head should be carefully examined for injuries to the skull, contraction of the pupils and restlessness usually being evident in cases of fracture of the skull with subsequent pressure. Should the patient be suffering from concussion of the brain, he will be pale, feel weak, giddy, nauseated, and confused if conscious, but in severe cases he lies in a state of complete relaxation, the extremities are cold, skin

pale and cold, pulse small, soft, slow, and weak. Respiration may be deep or superficial, rapid or irregular; he may be roused by shouting or pinching; the pupils may be unaltered, dilated, or contracted, or may be equal or unequal, but will react to light. In most cases of concussion vomiting will occur during reaction. The treatment depends on the severity of the case. Bring about reaction by inhalations of ammonia; surround the patient, after wrapping in hot blankets, with hot-water bottles; put a mustard plaster over the heart, and give a hypodermic injection of strychnin, one-thirtieth grain. Absolute quiet and rest in bed, with a plain diet and an occasional laxative or purge, is necessary in all severe cases. Never give alcoholic stimulants in such cases, and do not attempt to give any stimulant by mouth until certain that the patient can swallow.

What is a wound? A wound is a solution of the continuity of the soft tissues due to trauma.

Name and describe the various types of wounds. *Incised wounds*—Clean-cut wounds inflicted with a sharp-edged instrument; hemorrhage is usually profuse. *Contused wounds*—Result from a blow or squeeze which bruises and crushes the tissues and splits or ruptures the skin. *Lacerated wounds*—Result from tearing apart of the tissues; are irregular and jagged and are associated with more or less contusion. *Punctured wounds*—Made with pointed instruments, as needles, splinters, etc. The depth of a punctured wound greatly exceeds its surface area; it is dangerous in proportion to depth and to structures injured. *Stab wounds*—Inflicted by penetrating the tissues with a pointed or narrow instrument, as a dagger, knife, scissor blade, bayonet, or sword. Such wounds are narrow and usually very deep, and there is apt to result great hemorrhage and shock. *Gunshot wounds*—Produced by projectiles from guns and are tubular contused wounds. *Penetrating wounds*—Those that reach a body cavity. *Perforating wounds*—Those that extend through a body cavity. *Aseptic wounds*—Are free from pathogenic (disease producing) organisms. *Septic or infected wounds*—Those that contain such organisms. *Poisoned wounds*—Those in which some agent destructive to tissue is

present. *Operative wounds*—Those produced by the surgeon's knife.

What are the symptoms of wounds? Pain, hemorrhage, and loss of function are present in all; shock may be present.

Give briefly the treatment of wounds of each type. *Contused* wounds, keep the part at rest, evaporating lotions; heat. *Incised* wounds, stop hemorrhage by compress wrung out of hot water or salt solution, ligation of vessels may be necessary; remove clots and foreign bodies; if wound is known to be sterile, it may be sutured without drainage; if infection is feared, an antiseptic may be applied (e. g., tincture of iodin), and, if sutured, wound should be drained. *Stab* wounds should be treated on the same general principles as the incised, but it may be necessary to enlarge the wound to control hemorrhage, secure antisepsis, or repair injured organ. *Punctured* wounds should be considered as infected. It may be necessary to open widely to secure thorough cleanliness; drainage should be used. *Lacerated* wounds; treatment for shock may be required; careful hemostasis is necessary because of the danger of secondary hemorrhage; antisepsis should be thorough, tincture of iodin is useful for this purpose; drainage is usually necessary; dressings should be large and loose. *Penetrating* and *perforating* wounds; secure rest, hemostasis, and antisepsis if possible; further treatment depends upon the part involved. *Aseptic* wounds; carefully avoid introducing infection, secure rest and hemostasis, protect by sterile dressings. *Septic* wounds; avoid excessive handling of tissue and strong antiseptics; hydrogen peroxid and tincture of iodin are useful; drainage is usually necessary.

Describe the treatment of wounds of the scalp. If they do not penetrate below the aponeurosis, shave an area about the wound, stop the flow of blood, clean thoroughly, and suture, preferably with silk; drain if infection is feared. If the aponeurosis is perforated the danger of serious infection is great and all the steps must be carried out with great care. Drainage is usually necessary.

Describe the treatment of wounds of the eye. *Foreign bodies;* remove by irrigation with boric-acid solution, or by cotton wound on a toothpick, if possible; no instruments should be used except by skilled hands. *Contusions;* rest and application of cold. *Penetrating wounds;* boric-acid irrigation and a sterile dressing; rest in bed. Sutures and applications of atropin or cocain solutions may be necessary, but should be used only by skilled hands.

What principles are to be observed in treating incised wounds of the extremities? Hemostasis by direct pressure or tourniquet; exposure and ligation of the bleeding vessels; repair of injured structures where possible; thorough cleanliness; free drainage; sterile dressings; rest.

What is the emergency treatment of wounds of the chest involving the pleura and lung? Avoid rough handling; cut away clothing; clean the surrounding skin; wash the wound; stop bleeding; cover with large sterile dressing and a tight bandage.

What is the emergency treatment of wounds of the abdomen? *Contusions;* if severe, the symptoms will probably be those of shock. Place in bed; remove clothing; lower head; keep extremities warm; hypodermoclysis or intravenous infusion of normal salt solution with or without adrenalin. Prepare for immediate laparotomy. *Penetrating* wounds; treat shock; stop bleeding if possible; keep at rest; apply sterile compress and tight bandage; nothing by mouth; prepare for laparotomy.

What are the principal kinds of hemorrhage? *Arterial,* from the arteries; blood is bright red and comes in spurts. *Venous,* from the veins; blood is dark and flows steadily. *Capillary,* oozes steadily and tends to stop spontaneously. *Primary* hemorrhage occurs immediately after the injury. *Intermediate* or *reactionary* hemorrhage occurs within the first four hours after injury, and may be due to release of clots or slipping of ligatures. *Secondary* occurs after 24 hours, usually due to sloughing, suppuration, or premature absorption of ligatures. *Internal* hemorrhage is bleeding into one of the large body cavities.

What are the symptoms of hemorrhage? Pallor, dizziness, faintness, rapid and weak pulse, subnormal temperature, rapid and irregular breathing, yawning or sighing, nausea or vomiting. If severe, there may be blueness of the nails, paleness of mucous membranes, dyspnea, syncope, collapse, and unconsciousness, followed by death.

What is the treatment of hemorrhage? First stop the flow of blood. Strychnin (gr. 1/60 to 1/20) or adrenalin chlorid (1/1000), hypodermically, may be given hourly until improvement is apparent. Keep warm with blankets and hot-water bottles. Keep quiet with head lowered and give warm drinks when swallowing is possible. Give normal salt solution by enema, hypodermoclysis, or intravenous infusion; the latter only after the hemorrhage is arrested.

What are the means of arresting hemorrhage? *Chemical;* for capillary bleeding, hydrogen peroxid and adrenalin are the most commonly used. *Thermal;* hot water will often stop moderate hemorrhage; the cautery may be used in spongy tissues. *Mechanical;* direct pressure may be used in emergencies and in slight bleeding; compression of the vessel above or below the wound by hand or tourniquet; acupressure, a needle is passed under the vessel and ligature wound around its free ends; forcipressure, pinching the bleeding vessels with forceps; torsion may be combined with forcipressure; ligation is necessary in bleeding from larger vessels.

At what points may pressure be applied to stop hemorrhage? The temporal artery in front of the upper level of the ear. The occipital artery between the tip of the mastoid and the occipital protuberance. In severe bleeding from the scalp a tourniquet passing around the forehead above the ears to the base of the skull will occlude all the arteries mentioned. The facial artery can be compressed as it crosses the lower border of the mandible in front of the masseter muscle. The coronary arteries in the lips by pressure near the bleeding point. The carotids by pressure on the common carotid over the transverse process of the sixth cervical vertebra. Wounds of vessels of the neck are often so dangerous as to justify direct pressure with the finger

in the wound. The subclavian may be compressed against the first rib behind the middle of the clavicle, thus controlling the circulation of the whole upper extremity. The brachial may be compressed against the middle of the humerus. The palmar arches by grasping a round body and bandaging the hand firmly over it. The femoral artery may be compressed in the groin or lower down against the shaft of the femur. The dorsal and plantar arteries of the foot can be compressed against the bones.

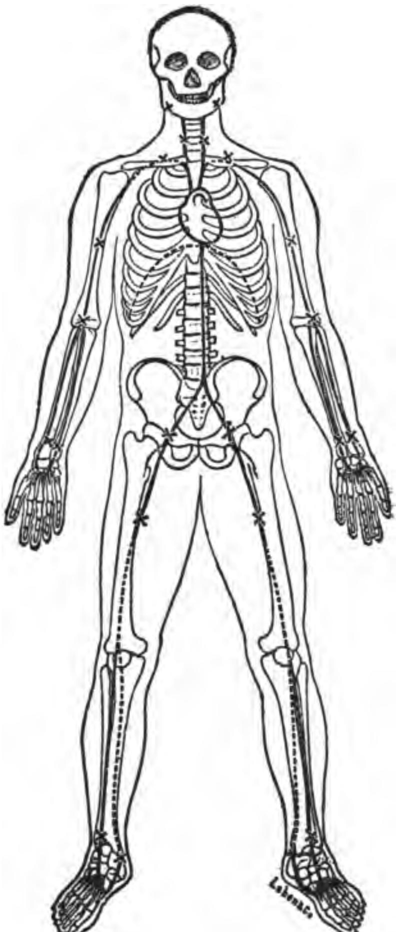


FIG. 43.—Skeleton with black and dotted lines showing the course of the arteries and X indicating the pressure points. (Mason.)

What is shock? Shock is a condition characterized by a general depression of the vital functions of the body brought on by sudden physical injury or profound mental emotion.

What may cause shock? Severe injuries, hemorrhage, grave emotional disturbances, extensive surgical operations involving much handling of the internal organs, prolonged anesthesia, severe chilling of the body, etc.

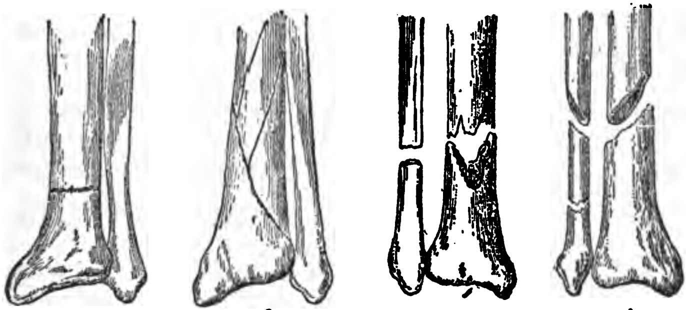
What are the symptoms of shock? The symptoms vary with the degree of shock and include subnormal temperature, shallow breathing, rapid, feeble and irregular pulse, cold, clammy skin with beads of perspiration standing out particularly on the forehead, and a state of being in which consciousness is as a rule preserved but the person appears stupid and indifferent. Nausea and vomiting are not commonly present. When delirium is present it is a grave sign.

What is the treatment for shock? Put to bed with no pillow under head and elevate the foot of bed; disturb patient as little as possible; avoid any operation except that of necessity, as to check hemorrhage; preserve body heat by applying external heat (wrapping in blankets, applying hot-water bottles, hot bricks, hot bottles, etc.), and give plenty of fresh air. If there is no nausea or vomiting present, if hemorrhage is controlled, consciousness is present, and there is no apparent injury to the organs of the abdomen, stimulants by mouth should be given and consist of strong hot coffee, tea, or whisky. Adrenalin chlorid, 1/1000 solution, 5 to 15 minims, may be given hypodermically or a teaspoonful in a quart of normal salt solution, or normal salt solution alone may be given intravenously or by hypodermoclysis. Hypodermic stimulation with strychnin, nitroglycerin, or the like may also be used. Shock may sometimes be prevented by the administration of morphin, blocking the nerves with cocain, and avoiding unnecessary handling of the viscera during operation.

What is a fracture? A fracture is a solution of the continuity of bone due to traumatism.

What are the kinds of fractures? *Simple* or closed; has a single line of solution without injury to the soft parts. *Multiple fracture;* has more than one line of solution of the same bone or several bones. *Comminuted fracture;* a fracture in which the bone is splintered into several pieces; comminuted fractures are frequently compound. *Complete fracture;* involves the whole thickness of the bone. *Incomplete fracture;* does not involve the whole thickness of the bone, includes greenstick, fissured, etc. *Impacted fracture;* a fracture in which

the broken ends are forcibly driven together or impacted at the time of injury. *Complicated fracture;* a fracture is said to be complicated if it is associated with serious injury to some important adjacent structure, such as rupture of large blood vessel



a b c d

FIG. 44.—Complete fractures. *a*, Transverse; *b*, spiral; *c*, dentated; *d*, oblique or multiple. (DaCosta.)

or injury to an internal organ. *Compound fracture;* there is an open flesh wound forming a direct channel of communication between the fracture and the surface. The fractured bone can be reached through the wound.

What is the emergency treatment of injuries involving the cranium? Rest in bed, head elevated and ice bags applied; clean and dress any open wound; if shock is present, depress the head, maintain body heat, artificial respiration if necessary.

What are the symptoms of fractures in general? History of injury, deformity, abnormal mobility, pain, loss of function, crepitus, and X-ray demonstration.

What are the principles of emergency treatment of simple fracture? Reduction, fixation in corrected position by splints and dressings; avoid unnecessary manipulation, as simple fractures are often made compound by careless handling.

What are the essentials sought in the treatment of compound fracture? There is an open wound to be treated and the hemorrhage from this wound to control. If at hand, the wound

is to be swabbed with tincture of iodin and a first-aid dressing applied after controlling the hemorrhage; the part is then to be immobilized. A sterile dressing can be improvised by boiling a clean handkerchief or other piece of cloth.

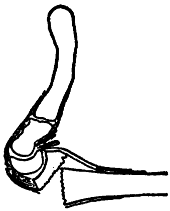


FIG. 45.—Effect upon the lower end of the radius of the cross-breaking strain produced by extreme backward flexion of the hand. (Pilcher.)

What is Pott's fracture? A fracture of the fibula just above the malleolus, accompanied by either fracture of the tip of the inner malleolus of the tibia or by rupture of the internal lateral ligament. There is a characteristic dislocation of the ankle, turning the foot outward (eversion).

What is Colle's fracture? A fracture of the lower end of the radius, accompanied by a characteristic dislocation of the wrist (silver-fork deformity), the hand being dislocated backward and dropping toward the ulnar side.

What is dislocation or luxation? A dislocation is the permanent slipping away from each other of the bones that form a joint, with locking of the bones in the new position. Necessarily the dislocation is attended with the tearing of the ligaments and often with rupture of the muscular attachments as well.

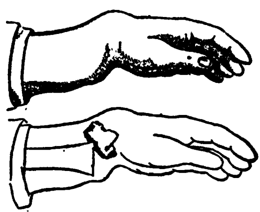


FIG. 46.—Deformity at the wrist consequent upon displacement backward of the lower fragment of the radius after fracture at its lower extremity. (Levis.)

What are the symptoms of dislocation? Immobility of the affected joint, sickening pain, numbness or tingling of the limb below the injury, marked deformity in the joint, with the limb fixed in an unnatural position. The limbs are always to be uncovered and the corresponding joints on the two sides compared.

What are the principal points in differentiating between fracture and dislocation? In fracture there is unnatural movement between the joints instead of immobility at the joint, and the movement is usually attended with a grating sensation and sound; the deformity is between the joints and there is usually shortening of the limb.

The dislocations of which joints are most frequently met with? Shoulder, lower jaw, and fingers. Dislocation of the shoulder occurs more frequently than all of the other joints in the body taken together because the glenoid cavity, the socket in which the head of the humerus fits to form the joint, is very shallow, so that the head of the humerus in the very free motion permitted easily rolls over the edge and becomes dislocated.

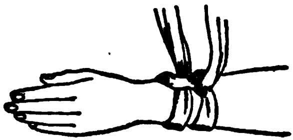


FIG. 47.—Clove hitch. (DaCosta.)

FIG. 48.—Subglenoid dislocation of the shoulder. (Mason.)

Name the two most common shoulder dislocations. Subglenoid, in which the head of the humerus lodges beneath the glenoid fossa; subcoracoid, in which the head of the humerus lodges beneath the coracoid process of the scapula.

Describe methods of reduction of these dislocations. Place the patient on his back; sit beside him; remove one shoe from your foot and place the foot in the patient's axilla; then using the foot as a fulcrum, draw the arm downward in the direction of its axis, then outward, and finally carry it across the chest; or Kocher's method may be tried as follows: Flex the forearm to a right angle, bring the elbow to the side, carry the hand and forearm outward as far as they will go, lift the elbow, and carry the forearm across the chest.

FIG. 49.—Reduction of dislocation of humerus by heel in axilla. (Erichsen.)

Describe symptoms and treatment of dislocated lower jaw. The patient can not speak or close the jaws and is in great distress. Wrap the thumbs well; stand in front of the patient, and while pressing with the thumbs in the mouth just back of

FIG. 50.—Kocher's method of reduction by manipulation: *a*, First movement, outward rotation; *b*, second movement, elevation of elbow; *c*, third movement, inward rotation and lowering of the elbow. (Ceppi.)

the last molars, at the same time with the fingers lift up the chin; the jaw usually will snap back into place. The thumbs must be withdrawn quickly to prevent their being bitten.

How is dislocation of the finger joints to be reduced? Pull on the dislocated end, at the same time bending it backward, if the dislocation is forward, or forward if the dislocation is backward, and push the joint into place. After reduction, splint or strap the finger.

FIG. 51.—Backward dislocation of finger. Reduction by extension. (Hamilton.)

What is sprain or stremma? A sprain is a dislocation that is automatically and immediately reduced. The extent of injury varies greatly; the displacement may have been so severe as to cause severe wrenching or tearing of the ligaments and tendons. In these cases there is great pain, much local swelling, and great discoloration. It is frequently difficult to determine whether the condition is one of sprain or fracture.

Outline the treatment of a sprained joint. Stop the subcutaneous hemorrhage by very hot applications continued for

several minutes, strap the joint, and put the part at rest. Massage and passive motion are important in the later treatment. If in doubt as to whether the condition present is a sprain or a fracture treat as outlined for the latter.

What is an abscess? A circumscribed collection of the liquified products of infective inflammation.

How should abscesses be treated? Evacuate pus as soon as its presence is evident. Incise, evacuate, drain. Strict asepsis must be observed. Never squeeze the abscess.

What is tracheotomy? An operation consisting of an incision into the windpipe and the insertion of a tube through which the patient can breathe. It is necessary in conditions where from growths, foreign bodies, or injury, breathing is obstructed at a point above the incision.

Under what conditions is immediate tracheotomy to be performed? Laryngeal spasm; edema following burns; injuries or disease such as diphtheria or cancer; foreign bodies in the larynx.

What is intubation? Intubation has in the majority of cases superseded tracheotomy. It consists in the introduction of a metal tube made to fit in the larynx and upper part of the trachea, so that the necessary opening is preserved in spite of inflammatory processes or swollen tissues. It is not applicable where there is a foreign body in the larynx.

Name the materials used as sutures and give the uses of each. *Silkworm gut;* the silk-producing gland of the silkworm stretched and dried. Stiff and bristly when dried but softened by hot water. It is strong, nonelastic, and nonabsorbable, and is used in large wounds and in the skin and fascia after laparotomy. Easily sterilized by boiling. *Silk thread* can be sterilized by boiling in plain water; it is nonabsorbable so that it is not commonly used in buried sutures and is usually used in interrupted skin sutures. *Catgut* (the small intestine of the sheep); either plain or chromicized, is absorbable, and is usually used for buried sutures; plain catgut for the tissues that unite quickly; chromicized resists absorption longer and is used

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where this characteristic is important. *Celluloid linen;* linen thread treated with celluloid, is nonabsorbable, and used under the same circumstances as silkworm gut. *Silver wire* is usually used in bone work, occasionally in skin sutures. *Kangaroo tendon* is used in special cases where it is desired to retain a suture for a long period but which will finally be absorbed. Used in the ligation of the larger arteries and in hernia operations.

What are the objects and methods of drainage? It prevents sepsis by removing bacteria and wound exudates; it relieves tension and so relieves pain. It is most often required in emergency surgery, in infected wounds, or accidental wounds which may be infected. The methods used are rubber tubes for large spaces, plain sterile gauze for removing serum and blood by capillarity, rubber dam, cigarette drains, glass tubes.

What substances are used for dressings and how used? Sterile gauze and sterile absorbent cotton are most important; medicated gauze is sometimes used. In emergencies use muslin, linen, or cheesecloth, sterilized by boiling. For aseptic wounds use dry dressings; for septic wounds moist dressings may be used. The dressing should be ample in quantity. Septic wounds should be dressed daily; aseptic wounds at longer intervals. In changing dressings every precaution must be taken against infection.

What are the purposes of bandaging? To protect the part; to give support; to limit motion; to fix a dressing; to act as a tourniquet.

What are the uses of splints? To immobilize a part; to prevent muscular contractions; to secure rest.

What equipment should be always ready for immediate use? Hand brushes, soap, fountain syringe, hypodermic syringe and tablets, sterile dressings, sutures and needles, bandages, splints, and instruments, such as are contained in the pocket case. Hand brushes should be sterilized and well wrapped; fountain syringe, tube, cannula, and glass nozzles should all be sterilized and wrapped; gauze sponges and compresses should be wrapped

and sterilized; sutures should be of various sizes of silk and silkworm gut, preferably in sealed glass tubes.

What is anesthesia? A condition of insensibility or loss of feeling, and as generally applied refers to that condition which is produced artificially by certain agents known as anesthetics.

What are the most commonly used anesthetics? Anesthetics are divided into (1) general, the most common being ether, chloroform, ethyl chlorid, and nitrous oxid, and (2) local, the most common being cocain, eucain hydrochlorid (beta), and ethyl chlorid.

Give a brief description of each of the above-named anesthetics. *Ether* is a colorless, volatile liquid and chemically the oxid of ethyl; for general use it is the safest and best anesthetic, but is contraindicated in certain diseases of the respiratory tract, as acute bronchitis. By reason of its great volatility it is difficult at times to use in the Tropics, and chloroform must of necessity be substituted. The chief danger from its use is the depressing effect on the center of respiration. It is administered by inhalation and with the admixture of comparatively little air. No special apparatus is required for its administration, as it can be given by the drop method on folded pieces of gauze, although the Allis inhaler or some form of closed inhaler is frequently used. The after-effects are apt to be unpleasant, and consist chiefly of nausea and vomiting, headache, and backache. *Chloroform* is a colorless liquid, less volatile than ether, and is chemically trichloromethane; for general use it is more dangerous than ether, though more agreeable to take and less irritating to the respiratory tract. The chief danger in its use is its depressing effect on the heart, and is therefore contraindicated in diseases of the heart. It is administered by inhalation and well mixed with air. As in the case of ether, no special apparatus is required, though many prefer to use a small mask. The after-effects are not apt to be as unpleasant as those following ether, but when present the symptoms are of the same general nature. *Nitrous oxid* is a gas which is stored in liquid form in steel cylinders from which the gas passes into a rubber bag and thence into a special mask

supplied with these outfits. It is used only where short anesthesia is desired, as in opening abscesses, extracting of teeth, etc., or as a preliminary to ether anesthesia in order to overcome the disagreeable first stages. Consciousness is lost quickly and recovered as quickly when the administration is stopped. Unpleasant after-effects are rarely seen. *Ethyl chlorid* is a very volatile, colorless liquid, but the mortality from its use as a general anesthetic is greater than that from the use of ether or chloroform. It is given by spraying it on several layers of gauze, so that it does not evaporate too quickly, produces anesthesia quickly, is recovered from rapidly, and usually without any unpleasant after-effects. Its toxic action is similar to chloroform. *Cocain hydrochlorid* is the hydrochlorid of an alkaloid obtained from several varieties of coca; it is the most widely used of the local anesthetics; it is usually administered in a 0.5 to 4 per cent solution by hypodermic injection. There is complete local loss of sensation and bad after-effects are comparatively rare. It is applied to the tonsils and fauces cautiously, on a swab, to produce anesthesia for operations in this region. To produce anesthesia in eye work the solution of cocain is dropped into the eye with a medicine dropper. *Eucain hydrochlorid* (beta), a white crystalline powder, largely used in ophthalmology in 2 to 5 per cent solution. Its solution may be sterilized without decomposition by boiling (difference from cocain). Dose, hypodermically, ½ gr. *Ethyl chlorid* produces local anesthesia by freezing the parts superficially, a spray of this fluid being directed upon the site to be operated upon, the freezing being due to the rapid evaporation. Careful dissection in ethyl chlorid local anesthesia is impossible. Used in opening boils, small abscesses, etc.

Preparation of the patient for transportation. In preparing a patient for transportation the method of transporting and the distance to be carried should be borne in mind. Of the many methods of transportation those which may be used for short distances and in cases of minor injuries are the following: A single bearer may carry a patient in his arms or on his back; two bearers may carry a patient by means of the Army

litter, the Stokes splint stretcher, or any improvised litter, or by forming a seat with the hands. For longer distances, and in cases of more serious injury, the travois, horse, or motor ambulance or on horseback are the principal methods. These different methods are applicable to various cases. Some injuries prohibit the use of one or the other, but all require preliminary preparation of the patient, having in view both the method of transportation and the distance to be traversed.

The patient should be examined thoroughly, the cause and the extent of the injury determined; hemorrhage, if present, arrested or controlled at once; fractures immobilized; wounds dressed; and if the patient is suffering from shock, reaction should be allowed to occur before attempting to move him, except in such cases as may result fatally without reaction. In the case of profound or severe shock it may be advisable to remove him to a hospital or place where more conveniences will be at hand for the proper treatment to bring about reaction. The health and comfort of the patient should always be the first consideration in the preparation of patients for transportation, and the method chosen should be such as would not materially lessen his chances of recovery.

What treatment should be given to a man suffering with toothache? The necessary essential is to determine exactly the cause, and this refers particularly to finding out whether you are dealing with a dead nerve or an exposed live one. The common tendency is to insert a pledget of cotton saturated with oil of cloves into the cavity and trust that this will ease the pain. This in many cases is absolutely contraindicated. Your first procedure should be to locate the responsible tooth, clean out the decayed food in the existing cavity, and before using any drugs apply first warm water to the cavity and then cold. If the cold water causes pain and the warm water does not, you are probably dealing with a live exposed nerve, while if the opposite results are obtained you most likely have a tooth in which the nerve is dead, and the heat, by causing an expansion of the accumulated gas, increases the pressure, and thus

the pain is increased, cold water having the opposite effect. In treating a live nerve oil of cloves is an excellent remedy, and is applied by saturating a small piece of cotton with the drug and inserting in the cavity. It happens in some cases that this gives no relief, even when the nerve is alive. In such cases there exists usually an inflammatory condition which requires treatment along the line of that used for any other inflammation. In treating a dead nerve it is essential that you find relief for the pent-up gas, which means opening up the pulp chamber by puncturing it with some sharp-pointed instrument going through the cavity of the tooth. It often happens that the condition has been allowed to go on, with a resulting abscess. This forms in the pulp cavity and extends through the root canals and frequently shows as a swelling on the gums. This should be lanced and treated as an abscess anywhere else on the body.

CHAPTER 3.

BANDAGING.

What materials are usually used for bandaging? Muslin, gauze, crinoline, flannel, rubber. Substances such as plaster of Paris and sodium silicate may be incorporated.

What conditions govern the amount of tension to be applied in bandaging? The circumference of the part; the greater the circumference the more force must be used, the thigh requiring greater force than the ankle. When a bandage is applied over splints, greater force is required to produce a certain pressure. When a bandage leaves the extremity of a limb uncovered, the extremity is liable to swell and increase the tension under the bandage; allowance for this must be made. Where a bandage covers a large dressing, greater force is required to produce a certain pressure. Change of position of a limb after the bandage is applied may alter the tension; a spica of the shoulder, applied with the arm elevated, is increased in tension when the arm is brought to the side. Each additional turn applied to the same part of a limb increases the pressure. Muslin shrinks when wet, and the possibility of this should be considered. Greater pressure is required by hard infiltrated tissue, like that around a leg ulcer, than can be employed in bandaging a loose, flabby part. An acutely inflamed part will not tolerate as much pressure as an edematous part. Interference with the function of a part must be considered.

How should a bandage be started? Place the outer surface of the free end on the point where it is to be started and hold it with the left hand; hold the roll in the right hand and make two turns.

How may a bandage be secured? By pinning; by splitting the end into two tails which are carried around in opposite directions and tied; by adhesive-plaster strips.

What principles should be observed in applying a bandage? Place the limb in the position it is to occupy. Begin at the extremity and bandage toward the body. Protect opposing skin surfaces by dusting powder or cotton. Make the pressure equal throughout. Observe the effect of the bandage on the blood supply of the limb.

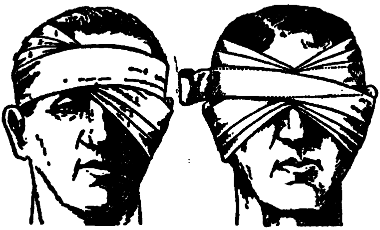

FIG. 52.—Crossed bandage (figure-of-8) of the eye. Crossed bandage of both eyes. (Eliason.)

What are the common types of bandage? Circular, spiral, spiral reverse, figure-of-8, spica.

How is a crossed bandage of the eye applied? Fix by two turns around occiput and forehead; from occiput, under ear, over eye, to opposite temple, to occiput; make these two turns alternately.

How is a Barton bandage of the jaw applied? Start below occiput, obliquely over parietal bone, across vertex, down over temple in front of ear, under chin, up in front of ear over temple, across vertex, back to starting point; then to front of chin and return to starting point; alternate these until three complete turns in each direction have been made.

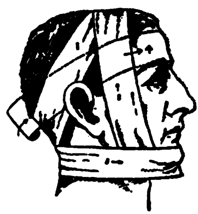

FIG. 53.—Barton bandage. (Eliason.)

How is the Velpeau bandage applied? The Velpeau bandage is used in the treatment of fractured clavicle and to support the shoulder when this joint is dislocated. It is also used as first-aid in fracture of arm or forearm until medical officer can be seen. A pad or folded towel is placed in the axilla of the affected side and the hand brought up to grasp the sound shoulder, the point of the

elbow being in front of the sternum; the site of the fracture is protected by a pad; the chest is well powdered and covered with a towel on whch the arm rests. The bandage is applied by a series of double turns. Start the bandage at the axilla of the sound side posteriorly, carry it across the back to the shoulder of the injured side, downward across the middle of the arm and under the elbow, across front of chest, returning to the point of origin; repeat this turn, but on reaching the axilla the second time cross the back and pass around the chest, including the arm; keep on with these turns, each alternate turn going over the injured clavicle and encircling the arm and body, the first turns advancing and the second turns ascending. Pin the crosspieces.

Fig. 54.—Velpeau (start). (Eliason.)

Fig. 55.—Velpeau (posterior view). (Eliason.)

How is the modified Velpeau bandage applied? Place the hand of the injured side on the opposite shoulder with padding between arm and chest wall. First turn, around body under elbow; second turn, around body over elbow; third turn, obliquely over front of chest to injured shoulder, down back of arm, under elbow; fourth turn, up in front of arm, over injured shoulder, across back to starting point. The finished bandage shows three complete turns about each part.

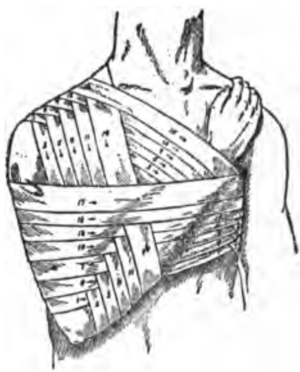

Fig. 56.—Velpeau modified (Dulles). (Eliason.)

How is the Sayre dressing applied? (1) A folded towel around upper arm; hold by strip of adhesive plaster. (2) Take a strip of adhesive plaster 4 inches wide and long enough to extend one and one-half times around the body; pass one end around folded towel and secure with safety pin; while assistant holds shoulder well back, arm is carried back and held by fastening the adhesive strip around the body. (3) A similar adhesive strip, with a hole to admit the point of the elbow, is started on the posterior surface of the injured shoulder, passes down the back of the arm, over the elbow, along the flexed forearm and hand to the well shoulder. A third strip may be passed around the body and arm and the whole covered by a Valpeau bandage.

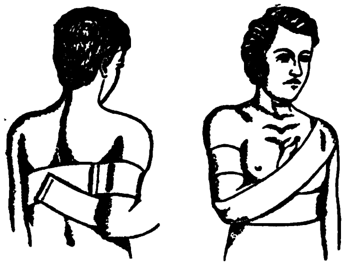

FIG. 57.—Sayre's dressing for fracture of the clavicle, showing application of first and second strips. (Wharton.)

How should a spiral reverse bandage of the upper extremity be applied? Fix by two turns at the wrist, across back of hand to fingers, a circular turn and spiral reverse turns to thumb, figure-of-8 turns below and above thumb, spiral reverse up forearm to elbow, spiral turns at elbow, spiral reverse up the arm, complete by a few spiral turns.

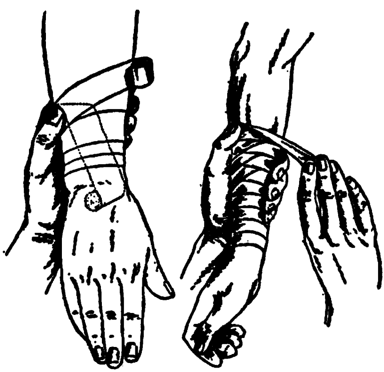

FIG. 58.—Spiral reverse. (Eliason.)

How should a figure-of-8 bandage of the elbow be applied? Fix by several circular turns over point of the elbow, then carry one turn about one-third its width above the point of the elbow, the next about the same distance below, alternate above and below the point, increasing the same distance each turn, crossing in front; secure by pinning in front.

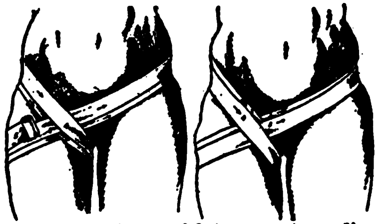

FIG. 59.—Figure-of-8 turns. Ascending spica. Descending spica. (Eliason.)

How should a spica bandage of the groin be applied? Fix by turns about the upper part of thigh, carry across groin above crest of ilium of opposite side, around body, back to starting place, crossing in front, and each turn about one-third its width above the preceding.

Describe the application of a spica of the foot and ankle. Fix the bandage around the ankle; then, for right foot, carry the turn obliquely across the dorsum of the foot to the ball of the great toe. A circular turn is made around the base of the foot across and up the instep, around the heel. The upper edge of the bandage should just grasp the heel, the lower edge being left loose. Now return to the lower instep, crossing the last turn in the middle of the foot and covering two-thirds of the width of the bandage. Repeat similar alternate turns around the foot and heel, taking care that those on the foot approach

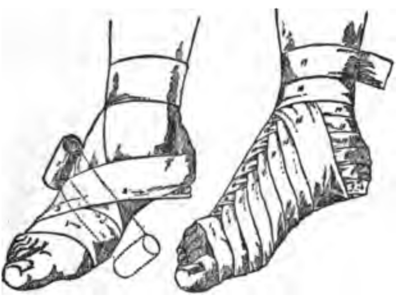

FIG. 60.—Spica of the foot (first step). Spica of the foot (completed). (Eliason.)

the heel and that those on the back of the heel ascend the ankle. The upper edge of the last turn around the foot should cover the lower edge of the first turn around the heel. The bandage is ended by one or two circular turns around the ankle. It will be noted that the last one or two turns crossing under the foot have one edge loose. This can be avoided by reversing the bandage on the side of the foot before going up the instep. To bandage the left foot, after fixing the bandage around the ankle in the above manner, direct the next down across the instep to the base of the little toe and then make a circular turn around the ball of the foot. From this point proceed as for right foot.

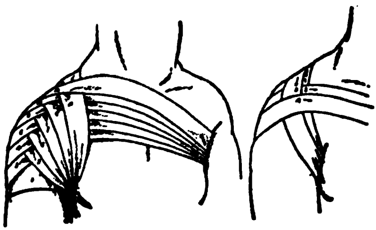

FIG. 61.—Spica of the shoulder. Spica loops of the shoulder. (Eliason.)

How is the spica of the shoulder applied? Make two circular turns around upper part of arm to fix, then coming from behind forward carry the bandage over the shoulder, across the front of the chest, through the opposite armpit, and return across the back to the shoulder. Make successive and advancing turns.

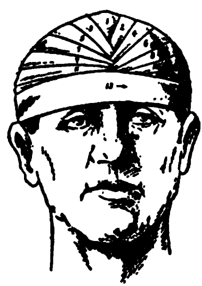

FIG. 62.—Recurrent turns. (Eliason.)

How would you apply a recurrent bandage of the head? Make two circular turns around the forehead and head; when the middle of the forehead is reached catch the bandage, take a half turn, carry the bandage to the occiput, let an assistant catch it, take a half turn, bring the roller to the forehead, covering a portion of the preceding turn; continue this process until the scalp is well covered; terminate with two circular turns around forehead and head; pin the cross pieces.

How would you apply an oblique bandage of the jaw? Make a circular turn around the forehead toward the affected side and a second turn to hold the first; take a turn to the back of the neck, carry it forward on the sound side under the ear and chin; now make a series of turns around the head and jaw in front of the ear on the injured side, but back of the ear on the sound side and under the chin; these turns successively advance on the injured side only; terminate by a reverse over the ear of the sound side and secure by taking two turns about forehead and occiput.

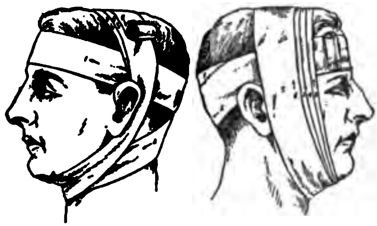

Fig. 63.—Oblique of the jaw (reverse side). Oblique of the jaw (right side). (Eliason.)

CHAPTER 4.

THE OPERATING ROOM AND SURGICAL TECHNIC.

Describe briefly an operating room. An operating room should have good overhead and side lights. It should have a northern exposure, with large windows to within 2 or 3 feet of the floor and extending to near ceiling. The floor and walls should be made of tiles, and there should be no sharp angles, crevices, or ornamentations to harbor dust, dirt, and microbes. It should be well ventilated and thoroughly screened against flies and other insects. There should be no unnecessary apparatus or furniture in the room, and what there is should be simple and easy to keep clean. The sterilizing, etherizing, wash, and dressing rooms should adjoin the operating room and be easily accessible. The instruments and dressings and linen should be kept in cabinets in a room adjoining the operating room when there is one available.

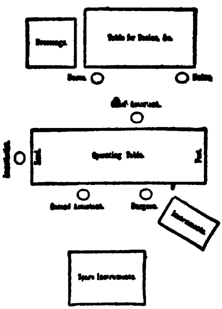

FIG. 64.—Diagram of arrangement of tables and assistants for abdominal operation. (Bryant.)

What are the necessary apparatus for an operating room? A good operating table and attachments with a stand or table on each side for instruments, sponges, dressings, etc., during an operation; a stand and stool for the use of the anesthetist; stands for various antiseptic and sterile solutions; a portable stand with an electric motor on it and attachments for lights, cauteries, saws, trephines, burrs, drills, etc.

Describe the apparatus of a sterilizing room. They consist of sterilizers for dressings, gowns, towels, etc., in which the heat is supplied by superheated steam under pressure; a tank for hot water and one for cold sterile water, each of from 10 to 20 gallons capacity; a small tank for keeping normal sterile salt solution at the proper temperature for use; an instrument sterilizer; a utensil sterilizer; and containers for sterile dressings.

In preparing for a surgical operation, what is the prime object to be attained? Asepsis of the operating room, apparatus, instruments, dressings, patient, surgeon, and assistants.

When is an object aseptic? When it is surgically clean; that is, free from all germs.

What is sepsis? Sepsis means putrefaction, which is due to germ infection.

What are antiseptics? Substances that prevent putrefaction by destroying germs or preventing their development.

What are bacteria? Very small organisms made up of a single cell, occurring singly or in groups, and belonging to the plant or vegetable kingdom.

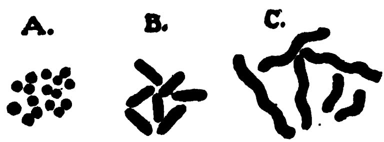

Fig. 65.—Types of bacteria. A, Cocci or micrococci; B, bacilli; C, spirilla. (Keefer.)

What three main classes of bacteria are there? (1) Cocci (micrococci) or spherical bacteria, which may occur singly (monococci), in pairs (diplococci), in fours (tetracocci), in chains (streptococci), in clusters like bunches of grapes (staphylococci), etc.; (2) bacilli, or rod-shaped bacteria, whose long diameter is two to ten times as great as the width, and whose ends are rounded or squarely cut off; (3) spirilla, or twisted rods, which are spiral rather than simply curved, and whose spirals may be single or as many as five or six.

How do bacteria reproduce? By simple division or cleavage of the organism, whereby two organisms are formed.

What is meant by bacterial spores? A number of bacteria possess the power of developing within their bodies under cer-

tain conditions a small highly refractive body called a spore. This spore has an extremely resistant membrane surrounding it, and sporulation seems to occur for the sole purpose of resisting an unfavorable environment. Many disinfectants used in a certain strength will destroy the parent organism but have no effect on the spore which later develops into an organism identical with the one from which it sprang. Some of the most important organisms, which are known as spore bearers, are the bacteria causing anthrax, botulism (a form of meat poisoning), malignant edema, and tetanus (lockjaw).

What is meant by the term protozoa? These are one-celled organisms belonging to the animal kingdom and represent the lowest division. They are the cause of many diseases, as a form of dysentery, syphilis, malaria, relapsing fever, sleeping sickness, etc.

How is asepsis produced? By the application of heat, either dry, steam, or boiling water.

How are objects made antiseptic? By chemical substances, usually in solution.

How are articles sterilized? Either by application of heat or chemical agents.

What are the principal antiseptics and antiseptic solutions used in surgery? (1) Alcohol, pure and dilute (50 per cent water).

(2) Corrosive sublimate or bichlorid of mercury, 1/1000 to 1/5000.

(3) Carbolic acid or phenol, 1/20 to 1/100.

(4) Cresol, 1/100 to 1/200.

(5) Boric acid, saturated solution.

(6) Tincture of iodin.

(7) Permanganate of potash solution, 1/100 to 1/5000.

(8) Oxalic acid solution.

(9) Harrington's solution: Bichlorid of mercury 1½ gms., hydrochloric acid 100 mils, glycerin 100 mils, alcohol 1,200 mils, distilled water 2,000 mils.

What is a normal salt solution? It is a 0.9 per cent solution of sodium chlorid (common salt) in sterile water.

Of what do surgical dressings consist? They consist of gauze or cheesecloth, muslin, cotton batting, flannel, wool, oiled silk and oiled muslin, rubber dam, bandages of different kinds, adhesive plasters, drainage tubes, sutures, ligatures, etc.

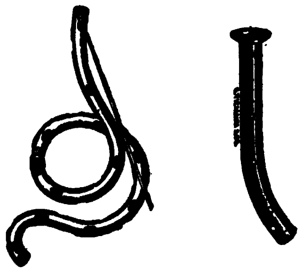

FIG. 66.—Rubber and glass drainage tubes. (Wharton.)

Dressings that are applied directly to wounds are usually gauze and are either dry or wet. Dry dressings are pads of sterile gauze and are generally used in aseptic wounds. Wet dressings are pads of sterile gauze soaked in some antiseptic solution, usually bichlorid of mercury 1/2000, and are generally used in infected wounds.

How are gauze dressings made up? There are various kinds of gauze dressings.

Gauze wipes or sponges, large and small, are very necessary during operations. They are made by cutting the gauze the proper sizes and folding in the cut edges so that they will not be exposed and threads left in the wounds.

Gauze pads for walling-off purposes are of various sizes. The cut edges should be folded in and stitched so threads will not remain in the wound.

Mikulicz pads are walling-off pads which have tapes from 6 to 12 inches long sewed to one corner.

Dressing pads are of various sizes and should have the cut edges folded in.

Sponges and pads are done up in muslin covers, each package containing one-half to one dozen, and sterilized by steam.

How would you prepare the operating room for performing an operation? The floor, walls, apparatus, and furniture should be thoroughly clean, having been scrubbed after the last operation; the operating table should be covered with a folded blanket, over which a rubber sheet is placed, and a steril-

ized sheet over that. The instrument tables should be covered with a sterilized sheet and the sterilized instruments and dressings arranged upon them. The basins for the antiseptic and sterile solutions should be sterilized, the solutions placed in them and covered with a sterile sheet or towels. The apparatus for saline solution for intravenous infusion should be set up ready for use.

Describe the sterilization of instruments, dressings, utensils, etc. The instruments, safety pins, and needles should be arranged on towels or gauze on the trays, the gloves wrapped in gauze, and all boiled in a 1 per cent carbonate of soda solution for about 10 minutes. Instruments having cutting edges should be protected by wrapping the blades with cotton. Needles and pins should be stuck into gauze pads.

The sponges, pads, operating gowns, caps, sheets, towels, and other dressings having been made into packages should be placed in containers which are placed in the dressing sterilizer and subjected to steam heat under about 15 pounds pressure for half an hour. All utensils used in the operation should be subjected to steam sterilization for one hour in the utensil sterilizer.

Hot water, sterile water, and normal saline solution should be on hand in abundance. Instruments, dressings, utensils, etc., that have been sterilized should be handled with great care and only by attendants whose hands have been sterilized.

Outline the process of "scrubbing up" as applied to the sterilization of the hands of the surgeon and his assistants. The most important part of any preparation involving the skin is a preliminary scrubbing with hot water and soap, using a nail brush. In operative work the so-called preparation of the hands, "scrubbing up," includes the hands and forearms to the elbows. The official liniment of soft soap (tincture of green soap) is usually preferred; this is an alcoholic solution of soft soap which can be sterilized and kept in flasks. A nail brush and nail cleaner (orange-wood stick), freshly sterilized, should be provided for each person. The preliminary scrubbing should

be invariably carried out by the clock, 10 full minutes being given, thus:

1. Wash thoroughly in a lather of hot water and soap for two minutes, rinse in running water, and change the water.

2. Clean the nails and remove loose epithelium around the nails with a nail cleaner. (Anyone actively engaged in surgical work should keep the nails very short.)

3. Scrub vigorously with the brush three minutes, paying particular attention to cleaning thoroughly between the fingers; rinse in running water and change the water.

4. Repeat the scrubbing until the 10 minutes are complete.

5. Rinse hands and forearms in alcohol to remove traces of soap or oil.

The preliminary scrubbing having been effectively carried out, there are two or three methods of chemical sterilization in general use. These chemical solutions should be contained in sterile basins of sufficient size and depth to allow the arms to be freely immersed.

First. *Harrington's solution* (formula given above). Immerse hands and forearms to elbow in Harrington's solution for three minutes.

Second. *Fürbringer method.* After scrubbing as above, immerse for one minute in pure alcohol; then immerse for three minutes in a 1 to 1,000 solution of bichlorid of mercury.

Third. *Schatz or Kelly method* (practically obsolete). After the mechanical scrubbing, immerse in a saturated solution of potassium permanganate until the skin is brown; immerse in a saturated solution of oxalic acid until the permanganate is decolorized; rinse in a sterile limewater to neutralize the acid; finally immerse in bichlorid of mercury solution, 1 to 1,000, for a full minute.

What other precautions are taken by the surgeon and his assistants to prevent infecting the patient? The surgeon and his assistants should have their chins, mouths, and nostrils covered with sterile gauze or mask made of muslin and sterile caps placed upon their heads. They should put on sterile operating gowns, being careful not to let the hands come in contact

with anything that is not sterile; they should put on sterile rubber gloves, pulling them well up over the sleeves of the gowns.

Describe an emergency process of sterilizing the hands. In an emergency, when there is not sufficient time to go through with one of the above outlined processes, the following method may be carried out: Clean the nails well and apply tincture of iodin thoroughly to all parts of the hands and well above the wrists. Do not apply any water to the hands.

What is a very necessary precaution to be observed during an operation? Never touch any sterilized instruments, dressings, or apparatus used in the operation unless sterilized yourself, and be careful not to touch against the operator or his assistants. When practicable, everyone in the room should have on a sterile gown.

CHAPTER 5.

NURSING.

What qualifications are essential in those who care for the sick? (1) Physical; good health, personal cleanliness. (2) Mental; education, observation, judgment, and order. (3) Moral; truthfulness, obedience, dignity, tact, courtesy, and sympathy.

Outline briefly the daily routine care for an average bed case. Bathe the face and hands and cleanse the mouth before breakfast. General sponge bath three times a week, and on days when bath is omitted back should be thoroughly rubbed with alcohol. Make bed every morning and change linen when necessary. At bedtime bathe the face and hands, cleanse the mouth, rub the back with alcohol, brush out the bed, and smooth drawsheet. See that prescribed diet is properly cooked, and hot food served hot. Report to the medical officer if patient's bowels do not move regularly. Note retention of urine and any peculiarities regarding urinations.

Mention nursing care to prevent bedsores. Keep parts of the body in contact with bed scrupulously clean and dry; keep the under sheet smooth and free from crumbs; remove pressure from any part where redness of the skin is noticed; give frequent light massage to points of pressure. In cases where skin is inactive, or where constant moisture exists, cleanse with soap and water several times a day; dry thoroughly; rub gently but thoroughly with small amount of oily substance all pressure points and folds of skin where moisture gathers.

Mention several methods of relieving discomfort and restlessness. Give alcohol rub; change drawsheet; turn pillows

and alter position of patient's body; soften glaring light; prevent unnecessary noise.

Fig. 67.—Clinical thermometer.

How would you relieve strain on abdominal muscles? Flex knees and support them with pillows.

Where is the temperature of the body usually taken and why? The mouth in normal cases; axilla, groin, or rectum when indicated by delirium, unconsciousness, or dyspnea. Temperature taken by axilla, groin, or rectum should be recorded accordingly.

State differences as compared with temperature taken by the mouth. Axilla and groin, 0.3 to 0.5 degree lower; rectum, 1 degree higher.

Describe taking temperature. Shake thermometer to 95 degrees. (1) Temperature by mouth: Ascertain whether the patient has recently taken anything very hot or cold; place thermometer under the tongue close to arteries, and direct lips be kept closed at least three minutes while the thermometer is in the mouth. (2) Axilla: Wipe surface thoroughly dry; keep the thermometer in place by holding the arm close to the side and flexing the elbow for at least five minutes. (3) Rectum: Cavity must be free from feces, thermometer remaining in place about 5 minutes.

What care should be given the clinical thermometer? It should be washed in cold water after using; kept in an antiseptic solution, from which it should be rinsed in cold water and wiped dry before using. Rectal thermometer should be marked and kept separate, as should thermometers used in infectious cases.

What is normal temperature? 98.6 degrees Fahrenheit, but may fluctuate from a fraction to a degree.

When is temperature of the body (1) maximum and (2) minimum? (1) 5 p. m. to 8 p. m. (2) 2 a. m. to 6 a. m.

Give some deviations of temperature and their significance. Collapse, 95 to 97 degrees; subnormal, 97 to 98.6 degrees; fever, 100 to 103 degrees; hyperpyrexia, 103 to 106 degrees.

Name the arteries most conveniently used in taking the pulse. Those lying near the surface immediately over a bone against which the artery can be compressed; the radial, temporal, facial, and common carotid are the most easily accessible.

Describe taking the pulse. Place two or three fingers firmly over the arteries for not less than one minute, alternately making and removing pressure. The body should be at rest and the arm recumbent if the usual radial pulse is recorded.

Describe normal pulse. The artery should feel firm and elastic; the blood stream should fill the vessel with moderate force at the rate of from 72 to 78 beats to the minute rhythmically and regularly.

Describe relation of pulse to bodily temperature. In many diseases the pulse rises with bodily temperature about 10 beats to 1 degree of temperature.

Mention common exceptions. In typhoid fever the pulse is low in proportion to fever; in scarlet fever it is disproportionately high.

Mention varieties of pulse. Slow or quick; low or high tensioned; frequent and running, when difficult to count; intermittent, when there is an intermission of a beat; irregular, when unequal in time and character; dicrotic, characterized by secondary impulse, sometimes mistaken for a beat.

What is respiration? The manner in which breathing is performed; it comprises inspiration, a period of rest, and expiration.

Describe breathing. An involuntary act accomplished under normal conditions without exertion, audible sound, or pain, accompanied by a rhythmic rising and falling of the chest wall and abdomen.

What is the rate of respiration? Adults, 16 to 20; children, 20 to 25.

What is the ratio between respiration and pulse? 1 to 4; it is varied by excitement and chilling or overheating of the surface of the body.

Enumerate types of respiration. Shallow, when volume of air is less than usual; dyspneic, when there is difficult breathing; tidal, or Cheyne-Stokes, beginning quietly, each succeeding respiration being louder and deeper until a climax is reached, which is followed by a complete pause before inspiration is again resumed.

For what different purposes are baths given? (1) Cleanliness; (2) inducing sweating and muscular relaxation; (3) reduction of fever.

How are baths classified with regard to temperature? Tepid (body temperature); hot, 100 to 110 degrees Fahrenheit; cold, 60 to 70 degrees Fahrenheit.

With reference to extent? General baths are either (1) tub or (2) sponge; local baths (1) sitz or pelvic, (2) foot.

Mention three baths most frequently used in routine nursing. (1) The cleansing bath; (2) bath to reduce temperature; (3) bath or pack to induce perspiration.

What preparation would you make for giving a cleansing bath, and describe process. Close windows, if any should be open near the patient; bring to bedside hot-water bag, bath blanket, towels, bottle of alcohol, soap, sponge or washcloth, and foot tub of hot water; (2) remove bed clothes; cover patient with bath blanket; place hot-water bag at feet; (3) beginning at head, bathe in order the face, ears, neck, and dry them; do not allow water to drip from washcloth or hands; avoid getting soapy water in eyes; proceed with rest of the body, exposing only one limb at a time, drying each part and giving short, vigorous rub with alcohol before exposing another part; use warmer for abdomen. The water should be changed once during bath. When turning patient use hand and avoid pressing finger tips in patient's flesh. Cleanse finger and toe nails. The addition of a little powdered borax to water will help to correct strong odor of perspiration.

How much time would you give to a bath for the reduction of temperature? About 20 minutes.

In giving such bath, what symptoms should you watch with unceasing attention? Signs of collapse which are: Increased pulse rate, sudden fall of temperature, pallor, blueness of finger nails, and shallow respirations.

In the event of collapse what would you do? Discontinue bath, wrap patient in warm blankets, apply hot-water bags, and administer stimulation as prescribed by the medical officer.

Describe the giving of a cold pack. Protect the bed with a rubber sheet; pass a wet sheet under and around the patient's body, tucking it in around the arms and legs so that no two skin surfaces are in contact; keep the sheet wet by squeezing over it water of the required temperature; rub briskly over the sheet.

What are the most important points to be remembered in giving a hot pack? Protect the bed thoroughly; do not expose the patient during or after the pack; do not place hot-water bags next to a wet blanket; watch the pulse at temporal artery; give fluids freely; leave the patient in wet pack 20 minutes; follow wet pack by warm, dry blankets for 1 hour, keeping ice on head and hot bags at feet; give vigorous alcohol rub when blankets are removed.

What preparation would you make for giving a salt glow and how should treatment be given? Prepare two large pads of gauze by dipping them in saturated solution of common table salt and allow to dry thoroughly before using. The treatment should follow warm bath. Rub with the pads, using gentle vigor until the whole body shows a pink, warm glow.

What special care should be observed in giving treatment baths? Avoid pressure upon abdomen.

How would you prepare a patient for operation? When practicable give a bath the day before, in bed if not able to go to the bathroom, and put on a clean night shirt or pajamas. If operation is in the morning, give castor oil and liquid petrolatum, one-half ounce each, at 4 p. m., and an enema in early morning. Give liquid diet for supper and nothing by mouth

after midnight. If operation is in the afternoon, give the oil and petrolatum at bedtime and enema at 10 a. m. Give liquid diet for supper and breakfast and nothing by mouth after 8 a. m. Shave the field of operation the day before, wash carefully with soap and water, using cotton so as not to scratch the skin; apply 70 per cent alcohol and allow the skin to dry; the field can then be protected by dry sterile gauze until patient is anesthetized. Just before operation gently wipe over the field of operation with benzin or ether, allow this to dry, and then apply tincture of iodin. Give hypodermically morphin sulphate gr. $\frac{1}{4}$ and atropin sulphate gr. $\frac{1}{150}$ one-half hour before operation. The day before operation have patient spray nose and throat with atomizer containing Dobell's solution every two hours. After a patient has been put to bed have him use a urinal when voiding in order to accustom him to passing urine while in bed. Always have patient empty his bladder before giving the hypodermic of morphin the day of operation. Remove any false teeth and grease face well before giving anesthetic.

What are the five vital points to be remembered? (1) Have the skin clean; (2) have the stomach empty; (3) have the bowels as empty as possible; (4) have the patient urinate before entering the operating room; (5) examine the mouth for artificial teeth; remove if found.

What is the one most important precaution to be taken in preparing an acute abdominal case? Avoiding the rupture of a possible pus sac.

What measures should be taken to avoid the rupture of a pus sac? Do not subject the patient to the slightest strain in lifting or moving him, and if enema is ordered, introduce the tube carefully and regulate the flow of water so as to avoid any sudden inflation of the bowel.

Describe routine care of patient following operation. Have room about 70°; admit fresh air, but avoid having bed in draft and avoid having glaring light in patient's eyes. Carefully place patient in warmed bed and avoid leaning on bed or jerking it; cover carefully with warm blankets, but do not retain hot-water bottles unless so ordered. Note and record

pulse and respiration; do not leave patient alone ; watch for restlessness and for tongue falling back over trachea. If patient vomits, keep head turned to the side, placing fingers behind angle of jaw and throwing it forward. In case of laparotomy, when vomiting is accompanied with severe straining, place hands on either side of wound, being careful not to uncover patient. Take the temperature as soon as practicable and thereafter q. 3. h. unless otherwise ordered. Note pulse at frequent intervals. Watch for symptoms of hemorrhage. Do not give water until ordered, but relieve thirst by washing out the mouth with lubricating mouth wash and by moistening the lips and tongue. Keep the mouth and nasal passages free from mucus. When water is allowed, give it hot or very cold, as warm water increases nausea. When ice is ordered, crush finely, so that it can be swallowed. Note time elapsing before urine is voided, and if eight hours pass, report the fact. Note such symptoms as tightening of bandage and evidences of severe pain. Flex knees over pillow to relieve abdominal strain. Relieve pain in small of back by carefully placing small pillow or soft pad under affected parts. Flatulence may be relieved by introducing well lubricated rectal tube or by ordered carminative enemata or turpentine stupes applied to abdomen.

Describe "Fowler's position." Place the patient in a semi-sitting posture, supported by pillows or back rest, at an angle of about 45°; let buttocks rest against the pillow, which may be secured to head of bed by long bandages to prevent slipping; place pillows under knees and elbows.

What is an enema? A fluid injected into the lower bowel by way of the rectum.

What special care must be exercised in giving an enema? Have nozzle well lubricated; avoid injecting air or chilled fluid. The tube must be filled with fluid, which should be allowed to escape until the fluid in the tube is the desired temperature; the tube should then be clamped to retain fluid while being inserted. If funnel is used, replenish before it is empty.

Describe position of the patient. Lying on left side or flat on back with knees flexed.

Special points to observe in giving enema. Insert the tube gently, upward, backward, and toward the left, using no force. Do not move nozzle about; proceed slowly; pause frequently to avoid peristalsis. When finished withdraw the tube gently, pinching it to avoid spilling any remaining fluid.

State the difference between low and high enemas. In giving a low enema the tube is passed only into the rectum 4 or 8 inches. In giving high enema the tube must be passed beyond the sigmoid flexure more than 8 inches, requiring patience and skill, as force must on no account be used.

What is enteroclysis and how is it administered? Intestinal irrigation which is given for shorter or longer periods, high or low, may be continuous or given by injecting stated amount and siphoning off the same; use special double tube and give treatment very slowly. Receptacle containing fluid should be about 2 feet above the body and pelvis of the patient should be raised higher than the shoulders.

Describe seepage or proctoclysis. A continuous flow, usually of normal salt solution at 100 F., into the rectum. The fluid is placed in a receptacle very little higher than the patient's head. The tube is partially clamped so that the fluid flows drop by drop. Guard against tube being rejected and consequent wetting of bed.

Give temperatures and approximate amounts of various enemas. (1) Purgative: Simple, soapsuds; temperature, 100 to 105 F.; amount, from 2 to 4 pints. (2) Stimulating: Saline, coffee with brandy or whisky; temperature, 105 to 110 F.; saline, amount, about 1 pint at a time; coffee, amount, about 4 ounces, with whisky, 2 ounces. (3) Nutritive: About 98.6° amount, from 4 to 6 ounces, given slowly. (4) To arrest hemorrhage, 110° to 120° or iced cold. (5) Oil enema: About 90°; amount, 6 to 8 ounces, given high and very slowly; follow with suds enema in 2 to 4 hours.

What special points should be observed in administering nutrient enemata? Cleanliness around anus and in fold of the

buttocks. Before giving enema wash out rectum with pint of warm water. Give very slowly, withdraw tube slowly, and apply small pad wet with boric acid to anus.

Describe the insertion of a suppository. A rectal suppository should be lubricated with oil and passed as far into the passage as finger will reach, the patient lying on the left side; protect finger with finger cot also lubricated.

What is a douche? A local bath of running water used to cleanse cavity; to apply heat or cold to inflamed surface; to arrest local hemorrhage; and to apply medicinal treatment.

Describe ear douche. Temperature of douche, 100° to 105°. Have patient sit erect in good light; place small basin under ear; hold auricle slightly backward and upward; do not push nozzle beyond opening of auditory canal; carry out irrigation very gently; when finished, sop moisture from canal with small bits of cotton until perfectly dry.

Describe eye douche. Place patient in chair with head held backward and slightly to the side of the eye under treatment. Douche should be elevated from 6 to 12 inches, according to nature of infection, but force must not be used. Hold upper lid well away from eyeball; direct stream toward the space between the inner angle of the eye and the root of the nose, causing the fluid to form a small pool, which overflows into the eye from the inner angle, avoiding the shock and wincing if stream be directed against globe; douche gently but thoroughly; repeat same process, holding loose tissue of lower lid gently down against the cheek bone. In case of infection and treatment for both eyes, use second syringe; observe strict asepsis.

Describe nasal douche. The stream should be small and force very slight, using fountain syringe; the patient leans forward, with chin depressed, to favor the return of douching fluid through mouth. If pain in ears follows, report fact to doctor.

What is catheterization, and how is it effected? Catheterization is the emptying of the bladder of urine by means of a tubular surgical instrument. A soft rubber catheter, previ-

ously rendered sterile, should be used if possible. Strict aseptic precautions must be observed to avoid infecting the bladder. The catheter, lubricated with sterilized oil, should be gently inserted into the urethra and passed in carefully until the urine begins to flow. When the bladder is empty, carefully remove catheter and compress the end to prevent the escape of the remaining urine.

What special care should be observed in catheterization for distended bladder? The entire quantity should not be withdrawn at one time.

What special points should be observed in bladder irrigation? Solution generally 100 to 110 degrees; amount, 1 or 2 pints. If funnel is used, inject about 8 ounces, then siphon off half the quantity, repeating injections of 4 or 5 ounces until bladder is sufficiently irrigated. Guard against introducing air. With use of double catheter about half a pint at a time may be injected.

What is lavage? A process to irrigate the stomach.

Describe lavage. Articles required: Rubber sheet on floor, a rubber tube of fairly large caliber, about 3 feet long; a bucket to receive contents; a pitcher suitable for pouring with one hand. Patient is in bed or seated in low chair; tube is moistened, placed far back on tongue; care is taken to direct tube over epiglottis into the esophagus; patient assists by act of swallowing; insert 18 or 20 inches; hold funnel about 1 foot above patient; pour in from a half to 1 pint of water; lower funnel and siphon off contents. Repeat until water is returned clear. Should blood appear, cease treatment and report at once.

What is gavage? Introduction of food into the stomach through a stomach tube.

What special precautions should be taken in gavage? Allow a few seconds to elapse after passage of tube that the muscular contraction may be quieted. Pour the liquid slowly; remove tube quickly and gently.

What special precaution must be taken in nasal feeding? Make sure the tube has not entered the trachea.

How is this proved? Put the outer end of tube into a glass of water; should bubbles of air appear remove at once, as tube is in trachea.

When tube is properly inserted in stomach what follows? Pour prescribed amount of food very slowly into funnel attached to tube; withdraw tube quickly but gently when amount has been taken.

Why are local applications employed? To relieve pain; allay inflammation; to overcome nervous conditions; to stimulate activity of an organ.

Differentiate between applications of heat and cold. Both act as local anesthetics, but heat penetrates farther than cold, and moist heat farther than dry; heat also affects muscular relaxation; cold is preferable in superficial inflammation.

Mention cold applications. Ice coil; ice poultice.

Mention rules in applying hot applications. Water must not be hot enough to scald; fill bag only half full, press out superfluous air; never give a patent uncovered hot-water bag; be sure that blanket intervenes between covered bag and body of unconscious patient; guard operative patient from contact with hot-water bags; do not leave same in bed with operative patient unless so ordered.

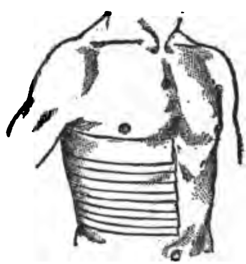

FIG. 68.—Strapping the chest. (Wharton.)

Describe a pneumonia jacket. It is made of cotton placed between two layers of thin muslin cut to fit body, with armholes and shoulder pieces covering thorax. Leave one side open, and fasten by tapes under the arm and over the shoulder. Tack cotton in place.

What is a poultice? An application of any substance which, when parboiled, holds heat and moisture.

Describe making and applying flaxseed poultice. The water must be boiling; the basin, etc., hot; all appliances at hand so that the poultice may not cool during preparation. Muslin to hold poultice should be 2 inches larger than required poultice.

Pour boiling water into the basin; stir in the flaxseed meal to which has been added one-third bran, stirring all the time. When mixture is cohesive and comes clean from side of basin turn out on muslin prepared on flat board, smooth with spatula to thickness of half an inch, dipping spatula in boiling water. Turn margins of muslin, roll poultice in warm towel and carry to patient. Test the poultice against the cheek before applying. The poultice should be applied directly to the skin, unless containing an irritating ingredient; cover with thin rubber sheeting and with a layer of cotton; keep in place with binder or bandage; remove in an hour or sooner if cold. On removal, dry surface and carefully observe the skin; cover with a layer of well warmed cotton to remain on until the next application, or as ordered.

Describe stupes. Take two layers of soft flannel, wringing as dry as possible out of boiling water, using stout roller toweling for purpose of wringing; apply directly to the skin and cover with light rubber sheeting and absorbent cotton; keep in place with bandage or binder. If stupe is ordered over broken surface, use sterile gauze and wring in a sterile towel, observing strict asepsis.

Describe effects of counterirritants and division of same. (1) Stimulation of circulation promoting absorption and secretion; (2) dilation of blood vessels to relieve congestion; (3) irritation of nerves produces a reflex action by which sensitiveness of other nerves is reduced. Divided into rubefacients, which redden the skin; vesicants, which produce a blister; escharotics, which cause sloughing.

Describe making and applying mustard plaster (sinapism). A paste made of flour and warm water, into which is stirred mustard in proportion varying from an eighth to a half, the latter proportion usually applied to the chest. If the skin is sensitive, mix with white of egg. Spread paste on thick muslin, turn in edges, cover the surface next to the skin with gauze. It is left on from 5 to 15 minutes. If official mustard leaf is used, dip in tepid water, allow to drip, apply directly to the skin or with layer of thin muslin for five to eight minutes.

After removal of sinapisms dry surface and cover until redness has disappeared.

Describe dry cupping. Use set of glass cups; wet rim to prevent its becoming too hot; rub inside with cotton soaked in alcohol; light; just before flame is extinguished invert cup over affected area. To remove the cup, insert tip of finger under rim. Another form of cup is that with a pump attachment as shown in illustration.

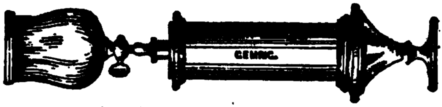

FIG. 69.—Cupping glass and air pump. (Wharton.)

Describe the application of Spanish-fly blister. The skin should be surgically prepared. Apply cantharidal collodion to covered surface with a camel's-hair brush, having first outlined space with vaseline; allow a few moments for application to dry; cover with gauze and finally with waxed paper. Examine area from time to time, four to eight hours being allowed for bleb to form. If it does not rise in this time, remove application and apply poultice over site. When blister is raised open by making snip at most dependent point; gently press out fluid with sterile cotton; apply dry sterile dressing. Observe strict aseptic precautions.

What should characterize the reporting of symptoms? Knowledge of the relative value of facts observed and accuracy in describing the same.

How are symptoms divided? (1) Subjective; reported by patient, such as pain, discomfort, nausea, etc.; these should be reported in words of patient. (2) Objective; the general condition of patient and the manifestations of the disease from which he is suffering as interpreted by the nurse.

Mention some important symptoms nurses should train themselves to observe. Evidence of bodily strength, condition of body with regard to flesh and muscles; condition of skin, presence and locality of sores and eruptions; color of skin, espe-

cially of face, and mucous membrane; presence and locality of abnormal prominences; swellings; dropsy in any part, especially the feet; abdominal tenderness; temperature of body; character of pulse and respiration; mental condition; facial expression; odor of breath; appearance of eyes; condition of nose, mouth, teeth, tongue; peculiarities of the voice; absence of appetite or excessive appetite; extreme restlessness; involuntary twitchings or contractions of muscles; insomnia; appearance of patient when sleeping.

What should a nurse know about medicines? The maximum and minimum doses; overdosage and treatment for poisoning by drugs in common use; idiosyncracies.

For what signs should a nurse watch? Symptoms due to idiosyncracy of patient and of overdosing; cumulative action of certain drugs not readily excreted from system.

How are medicines introduced into the circulation? By the stomach, rectum, cellular tissue, skin, and lungs.

What governs length of time required for absorption? Solubility of remedies, method of giving, and state of circulation.

Mention quickest and slowest methods of administering medicine. Subcutaneous, about five minutes; rectal, absorption requires three-quarters of an hour.

Give general rules regarding time to administer medicines. For prompt action, when stomach is empty; bitter tonics, shortly before meals; saline cathartics and quickly acting purgatives, before breakfast; laxatives, at night; acids, iron, etc., after meals and well diluted. A. c. medicines are given one-half hour before eating; p. c. medicines 20 minutes after meals are finished.

Mention several important rules for giving medicine. (1) Strict attention to this duty; (2) absolute accuracy with regard to dose; (3) observe time ordered and administer promptly; (4) read label twice before taking bottle from shelf, also before and after pouring medicine; (5) use graduated glasses and pipettes; (6) when pouring keep mark of quantity level with eye; (7) do not interchange minims and drops, there is a marked difference; (8) shake bottle before pouring medicine;

(9) hold bottle with label on upper side and wipe rim of bottle with gauze before replacing cork; (10) recork bottle immediately after use; (11) never mix medicines nor give at same time unless so ordered; (12) never allow one patient to carry medicine to another; (13) do not dilute more than is ordered nor than is necessary; (14) endeavor to make dose palatable, never dilute with warm water, use water very hot or icy cold; (15) place powders and cachets far back on tongue; (16) pulverize hard pills or triturates; (17) observe absolute cleanliness with regard to measuring glasses, pipettes, tubes, etc.

What general rules should be observed with regard to medicines and food? Starchy foods to be avoided when free iodin is given; milk and acids should not be given near together; avoid giving acids, salts, or salty food near a dose of calomel.

Give relative strength of a drug administered as compared with that given by mouth. (1) Subcutaneously; usually one-quarter to one-half the dose by mouth. (2) Rectum; usually twice as large.

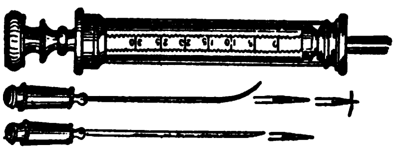

Fig. 70—Hypodermic syringe and needles. (Wharton.)

Describe giving a hypodermic injection of medicine. The drugs are generally specially prepared in concentrated form and should not be given unless fresh. Sterilize syringe by alternately filling with alcohol or carbolic 1/20 and emptying it, rinsing with sterile water. Sterilize needle carefully by same method or boiling one minute. Attach needle to syringe; load barrel of syringe with one or two drops more than are necessary; point needle upward,

Fig. 71.—Method of giving a hypodermic injection. (Wharton.)

press piston until all bubbles of air disappear and only the required amount of medicine remains in syringe, holding mark of same on a level with eye. Wash part chosen for injection (outer surface of arm, leg, thigh, or abdomen, avoiding course of blood vessel or bony prominence) well with alcohol; take up and hold firmly between thumb and first finger a cushion of muscle, stretching the skin; insert needle quickly in almost vertical direction and press piston gently; remove needle, pressing sponge quickly over hole to prevent escape of fluid; knead the spot gently for a few seconds; clean instrument carefully and thoroughly dry needle; leave wire in needle; guard point of needle.

Describe method of giving medicine by inhalation. (1) Dry; such as burning leaves of drug, patient inhaling smoke through cone, and by administering oxygen. (2) Steam; using inhaler, or utilizing kettle over alcohol lamp, croup tent, etc.

How is funnel held in administering oxygen? At side of face, slightly tilted forward or about 12 inches above mouth. If held directly over mouth, exhaled breath will be thrown back and effect of oxygen decreased.

Into what classes are diseases divided? (1) Communicable; transmitted directly or through an intermediary. (2) Contagious; contracted by direct contact with patient or by coming in contact with anything near patient which has not been promptly disinfected. (3) Infectious; caused by entrance into the body of pathogenic microorganisms.

Mention stages of infectious disease. (1) Incubation period between exposure to disease and appearance of symptoms; (2) invasion, appearance of active symptoms; (3) febrile or active stage; (4) eruptive stage peculiar to some diseases.

Give general rules in caring for infectious diseases. Discharges and excreta should be burned or disinfected. The linen and utensils used by patients, the hands of nurse and hands of patients should be thoroughly disinfected. Never place soiled linen taken from bed patient on tables or chairs, but put same immediately into pail containing water kept for this purpose, and keep submerged until such time as the linen can be disin-

fected. Disinfect linen by live steam, boiling, or soaking in formalin solution one-half per cent, or carbolic 1/40. Wear gown while caring for patient; disinfect hands *immediately* before touching anything.

General rules to be observed in contagious diseases. Isolation; entire absence of all articles not absolutely essential; a hanging sheet, wet with disinfectant, inside of closed door; take nothing from room until disinfected. Dishes should be placed in metallic vessel containing water and boiled. Bed linen should be taken away in wet sheet; excreta removed in vessel containing disinfectant, keeping disinfectant in vessels not in use, rinsing same in hot water before giving to patient. Observe absolute cleanliness for patient, giving special care to mouth, nose, ears, hands, nails, buttocks, and perineum. After recovery, patient should be given a warm antiseptic bath. Hot water and soap should be in readiness for medical officers' use. At close of disease, upon removal of patient, seal all cracks and openings in room, thoroughly fumigate before giving routine cleaning.

Give general rules for febrile cases. Fresh air, quiet; guard eyes from glaring light; observe extreme cleanliness with regard to patient and nurse; apply cold to head and heat to feet; keep mouth, teeth, and tongue clean; give necessary cooling drinks; follow prescribed diet; guard against sudden delirium; watch for sudden fall in temperature; watch pulse closely; screen food from flies and keep from sight of patient; note evacuations and urinations.

What important precautions and special symptoms should be kept in mind by the nurse in certain diseases?

Diphtheria.—Exercise great care when spraying throat of patient; watch pulse for cardiac weakness; note regurgitation of food as indicative of paralysis.

Dysentery.—Watch for signs of hemorrhage; fresh air, quiet, and application of external heat are necessary.

Influenza.—Use precautions for infectious diseases.

Malaria.—Keep patient well covered with blankets during chill; apply heat to feet, axilla, and over heart; give hot drinks

unless there is nausea; apply cold to head; note time between chills.

Measles.—Precautions for contagious disease: Give special care to eyes, cleansing and bathing same with 2 per cent boric acid; guard against chilling of skin, which may cause a nephritis.

Meningitis.—Precautions for infectious disease: Keep room cool and dark and watch for symptoms of otitis media and for inflammation of eyes.

Mumps.—Contagious disease; frequently cleanse mouth.

Pneumonia.—Infectious disease; note stages; watch pulse and respiration; note color of sputum; keep patient quiet; never leave an ill pneumonia patient alone; do not restrain so as to interfere with movements of chest; watch for heart failure and edema of lungs. Act promptly when temperature drops suddenly; apply heat and give hot drinks.

Scarlet fever.—Contagious disease; watch pulse; look for evidences of suppuration of lymph nodes in neck; keep room well ventilated at about 68°; measure urine and note change.

Typhoid fever.—Note temperature and pulse for evidences of hemorrhage, perforation, or cardiac failure; keep patient quiet and in a recumbent position, supporting back with pillow when turned on side; give special care to mouth, tongue, and hands of patient, disinfecting the latter; note character of stools and measure urine; guard against overdistention of bladder; insert rectal tube for relief of gas in intestine; guard against bedsores, which are prone to develop, due to protracted course of fever and emaciation. Rigidly follow diet ordered; guard against overfeeding during convalescence.

Tuberculosis.—Careful disinfection of discharges, bedclothes, and dishes; give fresh air, but protect from draft, and avoid chilling of patient. The nurse should make a special effort to induce patient to eat nourishing food.

What knowledge is essential in giving massage? Knowledge of anatomy; general knowledge of origin and insertion of prin-

cipal muscles; location of larger arteries, veins, and nerves and their functions.

Give general rules for massage treatment. (1) Wash hands before and after treatment; place patient in a comfortable position; in beginning a manipulation loosen all bands and restricting articles; use moderate force; increase gradually and decrease toward end of movement; begin with effleurage given toward the heart with palms of hands or cushions of fingers and thumbs. (2) Give friction with heel of hand or cushion of thumb or finger in successive circles, using considerable pressure; follow friction effleurage. (3) Pétrissage or kneading done with hands or cushions of fingers and thumbs. The muscles are stretched away from bone in direction of vein current, beginning above and working downward. Never allow hand to move on skin; follow with effleurage. Give movements slowly and evenly.

When is massage counterindicated? In all inflammatory conditions associated with pus; in skin diseases.

What general knowledge should a nurse have of food? A nurse should have some knowledge of the chemical contents of food, the action of different food materials on the body, and the food suitable to be given under certain conditions.

Give some general rules for diet in disease. Patients suffering from diseases of nutrition should have easily digested foods, milk, eggs, rare beef, sweet fruit.

Cardiac cases.—Limit liquids, fats, and carbohydrates; give highly nutritious food.

Diabetes.—Eliminate sugar and starches; give larger amounts of fats and sweeten with saccharine.

Diarrhea.—No solids; give foods that will be partially or entirely digested in stomach.

Dyspepsia.—Give food that is simple, in small quantities; avoid gravies and sauces; direct food be well masticated.

Nephritis.—Limit proteins; give a general milk diet, vegetables, and farinaceous food.

Give general rules for service of food. Prepare tray with absolute cleanliness in appointments and such regard to daintiness as possible; have sufficient articles on tray, but avoid appearance of crowding; do not serve too many foods at one time and do not serve large portions. Note seasoning of food and temperature; have hot food served hot, in heated dishes, and cover same in transit; remove all trays and traces of food as soon as possible; discourage having foods and drinks in sick room, but when this is unavoidable, cover same closely and keep from sight of patient.

CHAPTER 6.

HOSPITAL DUTIES AN WARD MANAGEMENT.

Under whose management are hospital wards of the United States Navy? Hospital wards are under the general supervision of the executive surgeon, and each ward is under the direct supervision of a medical officer detailed for that purpose.

The chief nurse has general charge of the wards, and each ward is under the direct charge of a nurse detailed for that purpose.

Members of the Hospital Corps detailed for ward duty are under the direction of the nurse in charge, who is responsible for the care and nursing of the patients and the management of the ward. In the absence of the nurse, the senior member of the Hospital Corps is in charge of the ward.

Who have charge of venereal wards? Venereal wards are in charge of members of the Hospital Corps with others detailed to assist. Under the direction of a medical officer they administer all medicines, give all treatment, including venereal prophylaxis, do all dressings, and are responsible for the care and nursing of the patients and the order and cleanliness of the wards.

Who have charge of wards and patients aboard ships of the Navy? Hospital corpsmen have charge of the sick quarters on board fighting ships and the wards on hospital ships, and have to perform all the duties of the Female Nurse Corps.

What duties have members of the Hospital Corps to perform on hospital ships other than their professional duties? They are detailed as signalmen on the bridge, as orderlies for the commanding officer, as messmen for the Hospital Corps, and for other special duties.

What steps would you take upon admission of a patient? Take his name, rate, and ship or station from which received, name and address of nearest relative or friend, and any other information called for on the admission slip, which is then sent to the executive surgeon's office. When necessary and practicable give a shower, tub, or sponge bath, as the case may require; put on a clean hospital shirt or pajamas and put to bed until seen by a medical officer. Inspect the patient carefully, note pulse, temperature, respiration, and examine carefully for skin eruptions, ulcers, tumors, swellings, vermin, hemorrhoids, varicocele, hernia, gonorrhea, or other evidences of venereal or contagious diseases and any other abnormalities. His money and valuables should be listed, put into an envelope with his name on it, and turned over to the executive surgeon for safekeeping. The patient's toilet articles, papers, books, trinkets, and articles of clothing needed in the ward should be placed in his bedside locker and his other effects turned over to the bagroom keeper.

Describe briefly the routine duties of a ward. Bed patients should be bathed, teeth brushed, and hair combed as soon after reveille as practicable and given their breakfasts promptly, after which their medicines should be served.

The dishes should be cleared away and the beds made up as soon as practicable after breakfast, and then the floors should be swept and the ward dusted, or the vacuum cleaner used. The ward should then be straightened up and patients' temperatures, pulses, and respirations taken before sick call, after which treatment should be given, dressings done, diet sheets made out, medicines and other supplies for the day obtained, and other directions of the medical officer carried out. Dinner should be served at the regular hour, dishes cleared away, temperatures, pulses, and respirations taken, medicines served and wards policed. Between dinner and supper there is usually considerable time for recreation; but the necessary work of the ward must be carried on.

After supper clear away dishes, police ward, take temperatures, pulses, and respirations, and serve medicines before sick

call. After sick call draw medicines, police ward, and see that all patients are present and in bed at taps.

What records should be kept in the ward? (1) A record book of patients, with their names, rates, stations, diagnosis, and treatment.

(2) A ward property book in which are listed all apparatus, utensils, linen, furniture, and other articles issued to the ward. An inventory of the linen should be made every week and of other property once a month.

(3) A ward order book in which are recorded directions from the medical officers and nurses in charge, instructions to night nurses, and list of patients detailed for light duty in wards and elsewhere.

(4) A daily ward medicine sheet should be kept by the nurse in charge on which should be kept a record of all medicines drawn and to be administered.

There should be a ward medicine closet, which should be kept locked, except when the nurse is present or medicine is being served. The care, dispensing, and use of proper containers for poisons should be as prescribed in the Manual for the Medical Department.

Medicines should never be left in the ward or with patients to take, but should be given by the nurses in charge or hospital corpsmen on duty.

Give general precautions to be observed in the care and making of beds. Beds must be kept clean, free from vermin, and comfortable. The lower sheet should be kept smooth by firmly tucking under the mattress, pinning it when necessary. No clothing, papers, books, food, pipes, tobacco, or other articles should be kept under the pillow or mattress.

What is very necessary in a fracture bed? Prevent sagging by placing under the mattress either a full-size perforated board, a frame of slats, or a number of separate slats.

Describe the different steps taken in bed making. The mattress, with cover on it, should be placed evenly upon the springs and smoothed out. The sheet should then be unfolded, placed upon the bed, and neatly tucked under the head, foot, and

sides of the mattress. The top sheet should then be placed on the bed, with the upper border even with the head of the mattress. The blanket and spread when used should be placed on the bed with the upper border about a foot from the head of the mattress, the end of the upper sheet turned down over them, and all neatly tucked under the foot and sides of the mattress, and the pillow placed at the head of the bed. In the case of bed patients the lower sheet should be fastened to the mattress, when necessary, with safety pins at each corner and the sides.

How would you prepare a bed for an operative case? In the same manner as for a bed patient, except that the pillow should be removed and a drawsheet pinned on the mattress in its place, as the patient's head should be kept low, since nausea will then be less probable and the bedding will not be soiled in case of vomiting. The bed should be warmed with hot-water bags or bottles in order to diminish shock. An extra blanket should be rolled up at the foot of the bed for use if necessary. The pillow should be pinned on the head bar to protect the patient from drafts and injury.

What equipment should you have convenient for an operative case? A bedside table on which should be towels, gauze pads, mouth gag, tongue depressor, tongue forceps, hypodermic syringe, hot-water bags, and two pus basins.

When and how would you apply a drawsheet? A drawsheet should be used in the case of a patient that is likely to soil the bedding. It is a rubber sheet about 3 by 4 feet, covered by a folded cotton sheet, spread across the bed on top of the lower sheet where the hips will rest, tucked under the mattress, and, when necessary, fastened at each corner of the sheet with a safety pin. The upper sheet, blanket, and spread are placed over this as in ordinary bed making.

How would you change the lower sheet of a bed patient? First, loosen all the clothing from the head, foot, and sides of the mattress; remove pillow and all the upper clothing except the sheet; then turn the patient on one side close to and facing the side of the bed from you; fold or roll up the lower sheet

lengthwise close up to the patient's back; then fold or roll up a clean sheet lengthwise to its middle and place the fold or roll close up to the dirty sheet, being careful not to soil it; then turn the patient on his opposite side, remove the soiled sheet, smooth out the clean sheet, tucking the borders under the mattress, and securing as before. If there is a drawsheet, remove it with the soiled sheet and put on another with the clean one.

How would you change the lower sheet in case of a patient who could not be turned on his side? This will require assistance. There should be one attendant on each side of the bed. Loosen the clothing all around; remove pillow and support the head, shoulders, body, and hips successively, folding or rolling the sheet down as you go and following it up with a clean sheet, which has been rolled or folded and which is unrolled or unfolded as the soiled one is withdrawn.

How would you change a bed patient from one bed to another? Move the beds close beside each other and then lift the patient gently across on the sheet.

How would you change a bed patient's mattress? Place the patient near one side of the mattress and pull the mattress half way off the bed on the other side. Place a fresh mattress alongside the other and lift the patient gently onto it on the sheet. Remove the old mattress and slide the new mattress over on the bed.

What other precautions should be observed in the care of the bed? The linen should be changed once a week or whenever it becomes soiled or wet or when a patient is discharged. The lower sheet should be kept smoothed out, as wrinkles in it may produce bedsores. The beds and linen should be inspected daily for bedbugs, and once a week the mattress and pillow covers should be removed and the bed, mattress, pillows, and covers given a thorough examination for bedbugs. If any are found, the bed should be thoroughly cleaned with an antiseptic and the mattress, pillow, and linen sterilized by steam.

What attention should be given bedside lockers? They should be inspected daily by a nurse or hospital corpsman. When able patients should be required to keep their lockers

clean and the articles arranged in an orderly manner, and when unable to do so this should be done by a hospital corpsman. Only toilet articles, letters, books, trinkets, and necessary clothing should be allowed in the lockers, and food should never be stowed therein.

Describe the care of the toilet, bath, and wash rooms. These are in charge of a hospital corpsman, who is responsible for their cleanliness and order, assisted by one or two convalescent patients. The floors should be scrubbed every morning and at other times during the day when necessary; the water-closets should be kept clean at all times and scrubbed out with chlorinated lime once or twice a week, and no dressings, bandages, or other articles, except toilet paper, should be thrown therein. The washbowls and bathtubs should always be cleaned after use. The walls, etc., should be scrubbed once a week and at such other times as may be necessary.

How would you dispose of dressings, excreta, etc.? All dressings should be burned as soon as practicable after they are removed. Sputum cups should always contain a strong antiseptic solution (1 per cent formaldehyd, 5 per cent carbolic acid, 1 per cent cresol, or 1/500 bichlorid of mercury) so the sputum can be sterilized at once. They should be frequently emptied into the bowls of the water-closets, cleaned, sterilized, and a fresh solution placed in them. Bedpans and urinals should be emptied into the bowls of the water-closet, cleaned, and sterilized.

In cases of typhoid fever, dysentery, cholera, etc., the stool should be covered and the urine diluted with one of the above antiseptic solutions and allowed to stand an hour or two before emptying. Bedpans, urinals, sputum cups, and other utensils should be cleaned and sterilized by steam.

What disposition should be made of soiled linen? When practicable, all linen should be sterilized before going to the laundry. In contagious or infectious cases the linen should always be sterilized by steam, or by immersing in one of the antiseptic solutions previously mentioned, before going to the laundry.

What steps should be taken to prevent the spread of typhoid fever? The ward should be thoroughly screened against flies and other insects. Should any get into the ward they should be killed and not driven out, as they would then spread the infection. The attendants should be very careful in handling patients to keep from being infected. A basin of 1/1000 solution of bichlorid of mercury and clean towels should be kept convenient in order that the attendant may sterilize his hands after handling the patient. Never eat in the ward or with unwashed hands. Sterilize all stools, urine, and other excreta thoroughly and all dishes, sputum cups, urinals, bedpans, and other utensils used by the patients, and also the bed and other linen. The water used for baths should be sterilized with an antiseptic before emptying. Sterilize clinical and bath thermometers after use.

The floors, walls, and furniture of the ward should be scrubbed periodically with soap and water and a strong bichlorid solution.

CHAPTER 7.

NAVAL HOSPITALS.

GENERAL PLAN, ARRANGEMENT, AND MANAGEMENT OF A NAVAL HOSPITAL.

Describe a naval hospital. The plan of the hospital at Portsmouth, N. H., has been adopted by the Bureau of Medicine and Surgery as the type hospital for the United States Navy. This plan has many features to commend it from a standpoint of economy, convenience, utility, and architectural beauty.

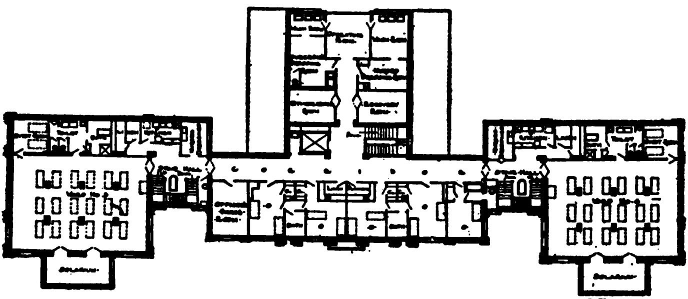

Fig. 72.—Floor plan of typical naval hospital.

The general plan of the hospital resembles a "T." The administration building occupies the front and center, with the wards situated on each side and the operating and subsistence building in the rear, all of which are connected to the central building by corridors.

In the basement are located the various storerooms, heating, refrigerating, and disinfecting plants, recreation, hydrothera-

peutic, wash, toilet, and X-ray, and some of the dining rooms, kitchen, library, dispensary, mortuary, and necropsy room.

On the first floor are the administrative and executive offices, laboratory, and examination room, two wards of 26 beds each, with dressing, quiet, and toilet rooms, diet kitchens and solaria attached, and the general mess hall and pantry are to the rear of the central building.

On the second floor are two wards, counterparts of the wards below. There are eight rooms, with toilets and dining room, for sick officers, a dressing room, a room for nurses, and a diet kitchen. In the rear are the operating, sterilizing, etherizing, dressing, wash, and recovery rooms.

On the third floor there are six rooms with toilets for sick officers, a dressing room, a room for nurses, a diet kitchen, and a large recreation room.

What other buildings should there be? The hospital grounds should be large and should contain, in addition to the main building, quarters for the commanding officer, executive surgeon, junior medical officers, Hospital Corps and Female Nurse Corps, power house, laundry, stables, and infectious camp and wards.

Who commands naval hospitals and hospital ships? The commanding officer of a naval hospital is a medical officer of the Navy and in his absence the executive surgeon or senior medical officer present on duty is in command.

What authority has the executive surgeon? The executive surgeon has charge of the junior medical officers, Hospital Corps, Female Nurse Corps, all patients, civil employees, and all departments of the hospital, and is directly responsible to the commanding officer for the discipline and management of the personnel and the conduct of all other affairs of the hospital.

By whom and where is the clerical work done and the records kept? The clerical work and the records of the hospital are under the direct supervision of the pharmacist, assisted by such hospital corpsmen as may be necessary. The work is usually done and the records kept in the executive surgeon's office. All official correspondence and records are examined

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by the executive surgeon prior to signing by the commanding officer.

Describe the dispensary. This is a room usually located centrally for convenience to the wards and contains small amounts of the various medical supplies for daily use, the larger supplies being kept in the medical storerooms. The dispensary is in charge of a chief pharmacist's mate, assisted by one or two hospital corpsmen, who compounds all prescriptions, dispenses all medicines, and is responsible for all medical stores in his custody and for keeping the room, apparatus, and medicines in proper condition. A record is kept of all prescriptions and medical supplies that are received, issued, or dispensed.

The more powerful and dangerous poisons are kept in a locker to themselves and great care is exercised in dispensing them. No unauthorized person should be permitted to enter the dispensary.

Describe the medical storerooms. The medical storerooms are in charge of the chief pharmacist's mate who has the dispensary, and contain all the medical and surgical supplies, except those in the dispensary and wards for daily use. They should be near the dispensary when practicable, for convenience in replenishing the supply there. When practicable, medicines should be kept in one room, surgical dressings and apparatus in another, and all explosives, inflammables, and stronger acids should be kept in a fireproof room apart from the other storerooms. All alcoholic liquors, morphin, cocain, and other narcotics should be kept together in a strong room, and access to them had only by a medical officer or the chief pharmacist's mate in charge.

Medical stores should be arranged systematically, either alphabetically or by class, in order that they may be easily found.

In each storeroom there should be a record book or card-index system containing an inventory of stores in that room, and all supplies deposited in or taken from it should be noted, so that the amount on hand can be accurately determined without the necessity of making an inventory.

Describe the laboratory. This is a room set apart for the purpose of making chemical, bacteriological, and pathological examinations, and has the necessary apparatus and chemical reagents for these purposes.

It is in charge of a medical officer, assisted by a chief pharmacist's mate and a pharmacist's mate, whose duties are to perform the routine work of examination under his direction and to keep the room, apparatus, and reagents in proper condition at all times. A complete record is made of each examination, a copy of which is sent to the medical officer requesting it and the original retained in the laboratory.

Describe the bag and hammock room and its management. This is in charge of a pharmacist's mate, and in it are stowed all the clothing and other effects of patients received at the hospital, except toilet articles, etc., that are needed for daily use and are kept in the patients' lockers. The effects of contagious patients should not be stowed until after thorough disinfection.

A card-index system or a record book should be kept in the room, and when a patient is admitted his name and the numbers on his bag and hammock should be recorded, the clothing inventoried, and the list checked by the pharmacist's mate in charge and the patient himself, if able, or by a pharmacist's mate from the patient's ward. This should be done again when the patient is discharged from the hospital.

Bags and hammocks should be stowed so as to be readily accessible, and at a certain hour of the day patients should have access to the room in order to procure such articles as may be necessary.

Describe the infectious camp and wards. Infectious camps and wards should be located some distance from the hospital and other buildings, preferably in the rear of them. Their personnel and outfit should be such that little or no communication with the hospital should be necessary. There should be at least six different wards or tents, isolated from each other, for the

various contagious diseases, so that the different classes would not come in contact with each other. Each class of diseases should have its separate toilet and wash room. Part of the camp or wards should be set aside for the detention of suspected cases.

Describe the linen storeroom and its management. This contains all the hospital linen and is under the charge of the chief nurse and a nurse. It is their duty to inspect all linen, carefully supervise the mending and marking, and keep a careful record of all linen received and issued and make accurate inventories at stated periods. Nothing but clean linen should be received and stowed.

It is advisable to have all linen stowed here except a few extra pieces for emergency. The several wards draw the amount required for daily use.

CHAPTER 8.

HYGIENE AND SANITATION.

What is hygiene? It is the science which treats of the preservation and improvement of health.

What is sanitation? It is the devising and applying of measures to promote public health.

In the preservation and promotion of health, what are the most important factors? Food and drink, personal cleanliness, clothing, and shelter.

FOODS.

Define food. Food is any substance which, when taken into the body, produces constructive metamorphosis; that is, produces growth or repair of the tissues, heat, energy, or functional activity.

Of what elements are foods composed? Principally of carbon, hydrogen, oxygen, and nitrogen, with which are combined in varying amounts calcium, sodium, potassium, magnesium, chlorin, sulphur, and iron. The first four are the nutrient elements of food.

How are foods classified? As organic and inorganic, both of which are present in varying amounts in all ordinary articles of food either animal or vegetable.

How are organic foods classified? As nitrogenous and non-nitrogenous.

What other classification have they? (1) Proteins, as meats, etc.; (2) hydrocarbons, or fats and oils; (3) carbohydrates, or starches and sugars.

What are nitrogenous foods? They are the proteins, as meats, etc., and contain nitrogen, carbon, oxygen, hydrogen, and sulphur.

What are the nonnitrogenous foods? They are (1) hydrocarbons, or fats and oils, which are compounds of glycerin and fatty acids, and contain carbon, hydrogen, and oxygen; (2) carbohydrates, or vegetable foods, embracing the various starches and sugars, and containing carbon, hydrogen, and oxygen, the two latter being in the proportion to form water (H_2O).

What are vegetable acids? They are nonnitrogenous substances and though not strictly foods play an important part in the preservation of health.

What are inorganic foods? They are water and mineral salts; the principal ones being chlorid of sodium or common salt, the phosphates of lime, potash, soda, and magnesium, with small quantities of sulphates and iron.

What are the principal articles of food of the protein group? They are lean meats, poultry, game, fish, whites of eggs, cheese, and milk. The cereals and some other vegetables (peas and beans) of the carbohydrate group contain considerable protein substance. Milk contains protein, fat, and carbohydrate in nearly equal amounts. It is capable of sustaining life indefinitely and is almost an ideal food.

What are the principal articles of food of the hydrocarbon group? They are all animal and vegetable fats and oils. Nuts contain a great deal of oil, and some cereals have considerable quantities of it. The yolk of an egg is mostly fat.

What are the principal foods of the carbohydrate group? All cereals, peas, beans, and vegetables generally, fruits, starches, and sugars.

What are accessory foods? This group includes a great number of condiments and beverages which although not necessary to existence are of importance as stimulants, aids to digestion, and as relishes to make other food more palatable.

What are the principal accessory foods? Tea, coffee, cocoa, meat extracts, alcohol, pepper, mustard, spices, flavoring extracts, and various other condiments.

What is the value of alcohol as an accessory food? Alcohol 1ould never be included in the dietary of a normal person, as

it is absolutely unnecessary and positively harmful when used regularly or to excess. A person can do quite as hard, if not harder, work and keep it up longer without alcohol than with it. Experience in wars and expeditions in all climates, where abstinence was either enforced by order or by circumstances, shows that soldiers endure more fatigue, are healthier, and fight better without alcoholic stimulants than with them.

Alcohol should never be taken during working hours or on an empty stomach. If taken at all, it should be after a full meal when the day's work is done. It is of value in certain diseases as a medicine, and should only be used as such, as should strychnin, opium, arsenic, cocain, and other narcotics.

In making up a dietary, what is very important? To have a variety of foods and to use the right proportions of nitrogenous and nonnitrogenous foods or proteins, fats, and carbohydrates.

About what is the proper proportion of fat, protein, and carbohydrate for a dietary? About one part of fat, two parts protein, and eight parts carbohydrate.

What is a calorie? It is the unit of measure of heat or energy produced by food when eaten, and is equal to the amount of heat or energy that is required to raise the temperature of 1 liter of water 1 degree centigrade.

What is the approximate value in calories per gram of the chief alimentary principles? Proteins, 4 calories; fats, 9 calories; carbohydrates, 4 calories.

About how many calories are required per day by a man doing moderate muscular work? About 3,000 calories.

What then would be about the proper amounts of the chief alimentary principles for the day's ration? Fats, 60 grams; proteins, 120 grams; and carbohydrates, 500 grams. In addition to these, mineral salts and vegetable acids are essential for repair and growth and preservation of health. Some condiments are also desirable.

Upon what does the amount of food that the body needs depend? Give examples. Upon the kind and amount of work done and upon the climate or exposure to heat and cold. Men doing hard physical work require more food than those doing

clerical work, and men exposed to cold require more food than those not exposed. Men doing clerical or professional work need from 2,500 to 3,000 calories, while those doing moderate to hard work require from 3,000 to 5,000 calories.

How is the commissary department of a hospital conducted? This is in charge of the pharmacist, assisted by such other hospital corpsmen and civil employees as may be necessary. He has charge of the mess hall, kitchen, pantry, and commissary storerooms. He purchases all the food, inspects and weighs, measures, or counts it when delivered, and issues it to the cooks and others who have to prepare it.

What are the chief points to be observed when inspecting fresh meats? They should have the stamp of the United States inspector on them; should be firm on pressure; should have a bright color; smell fresh; be clean; and well protected for handling.

What are the chief characteristics of good beef, veal, mutton, and pork? They should be clean; have a bright red or pink color; mutton and veal being not so bright as beef, and pork being of a much lighter color; should be firm on pressure; have a sufficient but not too large amount of fat; and should have a fresh, sweetish smell. Meat that is dark or reddish brown, moldy, and dirty, very soft on pressure, very lean, and with a stale, bitter, or putrid smell, is not good.

What are the chief characteristics of good poultry? It should be a creamy white or a bright yellow or lemon color, plump, fat, and firm on pressure, clean, and have a fresh smell. Poultry that is very dark with skin shriveled up, very soft or very tough, with a stale or putrid smell, is not good.

What are the chief characteristics of good fish? They should be firm on pressure, the gills should be bright red or pink, and they should smell fresh. Fish that are very soft, that have very dark or gray gills, or smell stale or putrid, are not good. Fish spoil very quickly and easily, and very often cause ptomaine poisoning, and great care should be exercised in examining them.

What are the chief characteristics of good fruits and vegetables? They should be firm, fresh, and ripe, not wilted, shriveled, or dried up, not unripe, overripe, moldy, or decayed.

What are the characteristics of good milk? It should have from 3½ to 4 per cent of fats as cream; its specific gravity should be greater than water; it should be creamy white and not of a bluish tint, and should be sweet to taste and smell, and there should be no sediment in it. Sour milk generally denotes that it is very old or dirty and contains a very large number of bacteria.

What are the chief points to be noted in the inspection of cereals, dried fruits, canned goods, etc.? See that all packages and cans are well sealed and that they have not been broken into. Examine carefully for worms, weevils, and other insects, molds, dirt, and other foreign matter. Note the odor, whether sweet and fresh or musty, moldy, sour, fermented, or putrid. In canned goods bulged-out ends denote that they are spoiled, while concave ends denote they are good.

What are the chief factors in the preservation of fresh goods? That they should be well protected and kept clean and cold. The commissary storerooms should be clean, dry, and well ventilated. They should be well screened against flies. Roaches, ants, and other vermin should be destroyed.

MESS MANAGEMENT.

What is the arrangement for mess management in a naval hospital? The pharmacist and his assistants have charge of the general mess hall, kitchen, pantry, and the preparing and serving of the food for patients on full diet, members of the Hospital Corps, and civil employees. After it is prepared by the cooks and served, it is inspected by the officer of the day.

The chief nurse and special nurses have charge of the special diet kitchens and pantries and the preparation of special diets which are prepared by special cooks or nurses. These diets are inspected by the chief nurse or officers having charge of the patients to whom they are served.

What classes of diets are there? (1) Full diet and (2) special diets, which latter are designated as (a) soft, semi-solid, or half diet, (b) liquid diet.

What is very necessary in serving foods? The food, dishes, and linen should be perfectly clean and arranged with taste. The attendant should have clean hands and clean clothes, as nothing is so disgusting to a patient as unclean, badly served food served by a dirty attendant.

WATER.

What is water? Water is a chemical compound of two atoms of hydrogen and one of oxygen (H_2O). *In addition to these, there is usually present nitrogen, carbon dioxid, ammonia, and various mineral substances in small amounts.

In what forms does water appear? (1) In a gaseous state, as steam or vapor; (2) in a liquid state, as water; (3) in a solid state, as ice, snow, hail, or frost.

What are the boiling and freezing points of water? Water boils at 212 F. or 100 C. and freezes at 32 F. or 0 C. Its maximum density is at 39 F. or 4 C.

Into what three classes, according to source, are waters divided? Rain or snow water, surface waters, and ground waters.

From what sources are they derived? Rain and snow water need no description, except to state that this refers to the collecting of it before it touches the earth. Surface waters include rivers, creeks, small streams, lakes, ponds—all resting upon the surface of the earth and in contact with the air; ground waters include springs and wells.

How do waters compare as to fitness for use? Rain water, if collected from clean, impervious surfaces in the open country and stored in clean tanks, is the purest of natural waters, but the system on a large scale is impracticable. Ground waters are more generally potable than surface waters, because ground waters are purified by filtration through the thick layers of earth. Deep well waters and deep spring waters are usually

good, but water from springs which go dry is suspicious. Ground waters may become contaminated by insanitary surroundings and thus be unfit for use, as may rain water when it comes in contact with dirty watersheds, tanks, cisterns, and the like, and surface waters in thickly settled communities.

What is the best practical classification of waters? Good, polluted, and infected.

What is good water? A good water is one of good sanitary quality as determined by physical inspection, chemical analysis, and bacteriological examination. It should be clear, colorless, sparkling, odorless, and agreeable to taste. It should contain no suspended matter or sediment. A careful chemical analysis should be made to establish the absence of any harmful products of a chemical nature and should be free from those bacteria which are the cause of human disease. The sanitary surroundings and the character of the country should be carefully considered, particularly in reference to the possibility of future contamination.

What is the distinction between a polluted and an infected water? A polluted water is one that contains organic matter either of animal or vegetable origin and may or may not be harmful to health; it is a suspicious water. An infected water is one that contains the specific microorganisms of human disease.

What amount of water is required per day for drinking purposes by the average man? This varies with the temperature of the air and the character and amount of exercise taken. Men require more water in warm weather and when performing hard manual labor. The average amount required per day, exclusive of that used for cooking, is about 4 pints.

What amount per man should be allowed for drinking, cooking, and washing? The minimum allowance for field operations should be not less than 2 gallons per day, and, when practicable, it should be 5 gallons or unlimited. The amount of water allowed generally depends on the available supply.

What is hard water? Hardness of water is due to the soluble salts of the alkaline earths, especially calcium and magnesium.

These salts form a curd with soap, instead of a lather, until all the lime and magnesium compounds have been decomposed. A part of the hardness known as temporary hardness may be driven off by boiling, and that which remains is known as permanent hardness. Rain water is always soft; surface waters vary, but are usually not very hard; ground waters are apt to be hard.

How may water be purified? (1) By heat, as in boiling or distillation; (2) mechanically, by filtration; (3) by chemical treatment.

Distilled water is used aboard all ships of the Navy for drinking and cooking purposes, and often for bathing also.

What method of purifying water is most applicable to field operations? Boiling is the most convenient and effective. Five minutes' boiling will destroy all disease germs usually found in water. It does not clear the water or remove dissolved organic matter. After boiling it should be aerated by shaking or pouring from one vessel to another. The Forbes sterilizer is a convenient apparatus for boiling, cooling, and aerating water.

What is filtration? It is a mechanical process by which water is freed from its impurities, as by a very fine strainer. Filtration can not generally be depended on for purifying water, except on a large scale at regular military posts or stations or at municipal plants. In the field filtration is often a great aid in making water potable, as it clarifies and removes suspended matter and sediment; but the water should be boiled after such filtration. The Berkefeld and other filters need careful attention and must be in perfect condition and sterilized frequently to be efficient; otherwise they are dangerous.

How would you purify water by chemical treatment? The most efficient way is by one of the methods liberating free chlorin, as from chlorid of lime, calcium hypochlorite (15 grains to 40 gallons of water), or the action of HCl on potassium chlorate. Another way is to dissolve 15 grains of alum in 3 gallons of water, stir it up well, and allow it to settle. The alum forms a sediment which carries down with it the suspended matter and bacteria. Ozone, iodin, permanganate of potash,

and sulphate of copper (1/100,000 for the latter) have also been successfully used in purifying water. The use of chemicals for purifying water is undesirable except in emergencies.

The Darnall filter is a simple and efficient method for purifying water, its principle being the precipitation by alum, followed by neutralization of any excess of alum by the addition of sodium carbonate. The Lyster bag is admirable for field use, utilizing the hpochlorite process.

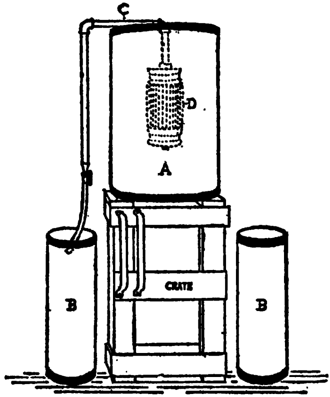

FIG. 73.—Darnall filter, showing method of operation. A, Filter tank, in which alum is added to water; B, water cans; C, siphon tube; D, siphon filter, wrapped in outing flannel. (Keefer.)

How would you improvise a filter for use in the field? This is done by taking a large barrel and putting a layer of coarse sand or gravel in the bottom of it. Then put a small barrel with the bottom perforated inside of this, letting it rest on the sand or gravel. Then put a layer of fine sand about 6 inches thick on this, then a layer of charcoal on the fine sand, and a layer of gravel on the charcoal. Pour water into the large barrel and it will filter through the gravel, charcoal, and sand and rise in the smaller barrel.

What are some of the most common water-borne diseases? The germs of typhoid fever, cholera, dysentry, and a great many intestinal parasites are carried by water. Hard water or water containing certain minerals often causes various intestinal disorders as diarrhea and constipation.

What are the chief sources of water contamination? Sewage and surface drainage in thickly settled districts.

How would you detect an excess of salt or chlorids in water? By adding a few drops of weak solution of nitrate of silver, which gives a milky precipitate in proportion to the amount of salt present.

What denotes organic matter in water? An offensive, putrid, or ammoniacal odor, especially on heating, or a brownish or yellowish color. Pure water is usually of a bluish or grayish color. In noting the color, a layer of water 1 foot high in a glass tube or cylinder on white paper should be used.

How would you collect a sample of water for examination? For chemical analysis about 2 liters are necessary, and about one-quarter liter for bacteriological examination. The flask and cork should be perfectly sterile. If taken from a tap, enough water should run to empty the branch pipes before taking sample; if from a pump, the stock should be emptied; and if from an open well, spring, stream, pond, or lake it should be taken from below the surface. The bottle should then be corked and the mouth protected with a sterile dressing.

PERSONAL HYGIENE.

What is one of the first requisites for good health? Cleanliness of the person and clothing. A daily bath should be taken when practicable. The hair should be kept short, finger nails kept trimmed and cleaned, teeth brushed twice daily, and the exposed parts of the body, face, and neck bathed frequently, and the armpits and genitals at least once a day. Dirty bodies and dirty and infected clothing are very often the cause of skin and other diseases.

What are the main purposes of clothing? To protect the body from cold, heat, wind, and rain; maintain warmth; protect it from injury, and to adorn it.

From what sources are the materials for clothing derived? From wool, hair, fur, feathers, silk, and skins of animals, and various vegetable fibers.

What determines the character of clothing that should be worn? The condition of the weather and the character of the service to be performed.

What material is generally used next to the body and what for outer garments? Underclothing is usually made of cotton and linen, and, while wool and silk are often used thus, they

are more generally used for outer garments, as are the other materials procured from animal sources.

What materials are most suitable for warm and cold weather? Generally speaking, cotton, linen, and silk are most suitable for summer, and wool, hair, fur, and feathers for the winter. As a rule, the vegetable fibers are used for underclothing in both warm and cold weather. They are good conductors of heat and poor absorbers of moisture, and hence are good for outer clothing also in warm weather. Wool, hair, etc., are generally used for outer clothing. They are poor conductors of heat and good absorbers of moisture; keep in the body heat in winter and keep out the heat of the sun in summer.

What precautions are most necessary in regard to clothing? It should be kept clean and dry. Underclothing should be washed frequently and well dried before putting on to wear. When water is not available for washing underclothes they should be dried and aired in the sun frequently. Woolen clothing does not stand washing and scrubbing well, so this should be done as little as possible.

What effect has the color of clothing upon the body? Color has very little effect upon the temperature of the body, except in the direct rays of the sun. Black and dark colors absorb the rays of the sun and are thus warmer, while white and light colors reflect these rays and are thus cooler. Some authorities think that dark colors have great influence in excluding certain injurious chemical elements of the sun's rays.

What effect has texture on the warmth of clothing? Loosely woven materials which have much air in their textures are warmer, as air is a poor conductor. Leather, rubber, paper, and other impervious material keep out winds and are warm for that reason.

What is probably the greatest danger to which the sailor and soldier are exposed? Venereal disease; that is gonorrhea, chancroid, and syphilis, which are very injurious to health, are often followed by the most serious consequences, such as bladder and kidney disease, frightful sores and ulcers, loss of vision and voice, aneurism, locomotor ataxia, paralysis, and insanity.

Venereal diseases are the cause of many discharges from the service for physical disability and more admissions to the sick list than any other disease. Syphilitics are liable to infect others, and if they marry may infect their wives and beget syphilitic children with all the evil consequences.

What is a great factor in acquiring venereal disease? Alcoholism, which incites and leads to sexual indulgence, and the two should be considered together. Neither one is necessary to health, and alcohol is very harmful. Alcohol lowers the resistance of the body to disease, and, though it temporarily stimulates, this is promptly followed by diminished resistance to both heat and cold. A man under the influence of alcohol is not cleanly in his habits or careful of his associates, does not observe sanitary precautions, lacks judgment, and is therefore much more liable to contract venereal diseases.

What is the only certain protection against venereal disease? The avoidance of impure sexual intercourse, and as practically all prostitutes are infected sometime the only safety from venereal infection is to abstain from sexual intercourse until after marriage.

What precautions should be observed after exposure to venereal infection? The urine should be passed directly after exposure, the parts should be thoroughly washed with a 1/2000 bichlorid solution or with soap and water, after which a good prophylactic remedy should be used.

Give the method for venereal prophylaxis. (1) Wash the penis thoroughly with a 1/2000 solution of bichlorid of mercury; (2) pass the water, and inject the urethra with a one-half to 1 per cent solution of protargol and hold for five minutes; (3) rub 33 per cent calomel ointment well into the foreskin, frenum, head, and shank of the penis.

This treatment should be taken as soon as possible after exposure, as the danger of infection increases rapidly with delay. Even with the most prompt and careful treatment venereal infection sometimes occurs.

What are some other very important considerations in personal hygiene? Regular habits, systematic exercise, ana regu-

lar hours for sleeping and eating. Great care should be taken in the selection of food and drink, especially in the Tropics, where it is best to avoid all native prepared foods and drinks. Native fruits may be eaten when not overripe or unripe, but the skins should be removed or washed thoroughly.

In the Tropics or in warm weather protection against the heat of the sun to avoid sunstroke is necessary. The head, neck, arms, and legs should be protected to avoid sunburn. The abdomen should be protected at night to prevent chilling.

AIR AND VENTILATION.

What is air? It is a mixture of about 79 parts of nitrogen and 21 parts of oxygen by volume, and about 77 parts nitrogen and 23 parts oxygen by weight. It contains also small quantities of carbon dioxid and aqueous vapor. Thus nitrogen constitutes about four-fifths and oxygen about one-fifth of the volume of the atmosphere.

What are the functions of these two elements? Nitrogen acts as a diluent for the oxygen which supports all animal life. Oxygen is always being taken from the air by respiration and combustion and returned to it in combination as carbon dioxid. Vegetable life takes up carbon dioxid and decomposes it, retaining the carbon and returning free oxygen to the air, thus maintaining the equilibrium.

What is humidity of the air? It is the moisture or watery vapor contained in the air, and the higher the temperature the greater is the capacity of the air for moisture. When air will contain no more moisture, it is said to be saturated. When cold air comes into contact with saturated air, the excess moisture is precipitated as rain or dew.

What are the chief impurities found in air? Dust, bacteria, organic matter, and carbon dioxid.

Of what are the organic impurities composed? Particles of epithelium, emanations from the lungs, mouth, nose, throat, skin, and intestinal tract, pus cells from suppurating wounds, and bacteria of various diseases. Dust contains various kinds of bacteria and organic impurities.

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What are some of the ill effects of overcrowding and vitiated air? Headache, dizziness, insomnia, nausea, and loss of appetite; when long continued there is loss of strength and diminished resistance to disease. Besides, many diseases, such as tuberculosis, pneumonia, erysipelas, influenza, and the eruptive fevers come from inhalation of bacteria from the air.

In what other ways may air be polluted? By the products of combustion in heating and lighting, as carbon dioxid is thus liberated in large quantities.

What amount of carbon dioxid is there in fresh air? About 4 parts in 10,000. This is normal, but the amount varies somewhat with the locality and surroundings. It is probably not harmful until after it exceeds 4 parts in 1,000, which limit is not often reached even in very badly ventilated compartments.

How is impurity of the air best indicated? By the amount of carbon dioxid present. While carbon dioxid may not be present in sufficient quantities to do harm, an excess of it generally indicates that there are other impurities present in harmful amounts.

What is ventilation? It is the process of removing vitiated air from compartments and replacing it with fresh air.

How is ventilation designated? As (1) natural, (2) artificial.

How is natural ventilation produced? By having openings in the walls, floors, or ceilings of compartments which permit of free natural circulation of the outside air. This can be best attained by having the openings on opposite sides.

What is a very great factor in effecting natural ventilation? The difference of temperatures between the outside air and the inside air, and consequently different densities which cause motion and diffusion in order to establish an equilibrium.

Why is proper ventilation easier to accomplish in warm weather? Because all windows and doors can be left open and the breezes and natural circulation supply fresh air in sufficient quantities. When the air is very still it is sometimes necessary to use fans to put it in motion.

How is artificial ventilation produced? By fans, blowers, pumps, windsails, air scoeps, and other mechanical appliances.

What two systems of artificial ventilation are there? (1) The supply system, in which fresh air is forced into a compartment; (2) the exhaust system, in which vitiated air is sucked or pumped out of a compartment.

How are living spaces ventilated on shore and at sea? On shore natural ventilation is generally sufficient to furnish all the necessary fresh air, but at sea artificial ventilation is very necessary, especially on the lower decks and in the holds, and on the upper decks when the ports have to be closed in bad weather. Toilets, pantries, provision storerooms, and compartments below the water line or that have no side ventilation should have exhaust as well as supply systems of ventilation.

What is necessary in any system for proper ventilation? At least two openings, which should be on opposite sides of the compartment.

How much air per hour is necessary to maintain a person in health and vigor? About 3,000 cubic feet; and as this much space is not available in buildings for each person, the air must be renewed frequently.

How frequently should the air of a room be changed? Not over five times an hour, as oftener than this would create too much draft, and thus be harmful.

What then is the minimum size of a properly ventilated room that one person should occupy? About 600 cubic feet, or about 8 feet square by 9 feet high. As ventilation is rarely perfect, a much larger space is usually required.

What proportion of floor space should there be in a living room? Not less than one-twelfth of the cubic capacity; that is, the ceiling should not be over 12 feet high, as there is little movement in the air above that, so that it is not available for use.

How many cubic feet of fresh air are required in hospital wards? Owing to increased effluvia and impurities from the sick, each patient should have about 4,000 cubic feet of fresh air per hour.

In supplying fresh air to patients and others what precautions are necessary? That the patient be protected from direct

drafts by screens and that the fresh air be of the proper temperature.

What are some methods for promoting natural ventilation of wards and rooms? In the absence of artificial ventilation, the supply of air must be regulated by the doors and windows. Ventilation is best secured by opening the windows at both top and bottom and on opposite sides of the room. Another method is to place a board under the lower sash and air will enter between the upper and lower sashes, or, better still, put a frame with muslin stretched on it under the lower sash and the air will filter through the muslin as well as come in between the sashes. It is sometimes necessary to flush out wards by opening wide the doors and windows, and in such cases the patients should be well wrapped and protected as if out of doors.

HEAT AND LIGHT.

How is heat distributed? (1) By radiation, in which heat is thrown off from a body in straight lines in all directions with equal intensity, which diminishes as the square of the distance increases; (2) by conduction through all solids, but to a very limited degree by liquids and gases; metals are the best conductors, then stone, then wood, and least of all wool and silk; (3) by convection in gases and liquids in which those portions which are heated rise and colder portions take their places. Thus a circulation of the liquid or gas is set up and the whole mass is warmed.

How is the heating of rooms accomplished? Mostly by convection, partly by radiation, and hardly appreciably by conduction.

Is there any relation between heat and ventilation? There is a very close connection between the two, especially in winter. Natural ventilation depends a great deal upon the difference between the temperature of the room and that outside, and the temperature of a room depends greatly upon the ventilation.

What is the ideal method of ventilation? When all the fresh air is supplied at the proper temperature; but this is rather difficult to accomplish.

At what temperature should living spaces be kept? From 65 to 70 F. or 18 to 21 C.

How is heat usually supplied? By open fires; by stoves; by hot air from furnaces; by hot water; and by steam. Gas, oil, and electric stoves and radiators are used to some extent.

How do they compare as to efficiency and economy? Open fires are the least efficient and economical, although they and hot-air furnaces are a very great aid to ventilation. Next to open fires stoves are least efficient and then follow hot-air furnaces, steam, and hot water, which latter heat is the most economical of all after the system is installed. Rooms are sometimes heated by gas or oil stoves and radiators, but they are not very generally used. Electricity is sometimes employed for heating rooms, and though probably the most sanitary method it is very expensive.

What methods of heating are most generally used at present? Open fires, stoves, and hot-air furnaces are generally out of date, but are still much used in the country, villages, towns, and small cities, while hot air is still often used in the older houses of large cities. Hot water is generally used for dwellings in cities and for buildings not over four stories high, while steam is used for the larger buildings and on board ships.

What is the principle on which hot water and steam systems of heating work? They work on the principle of convection. A portion of the water is heated or turned into steam and it becomes lighter, rises and goes into the pipes and radiators, while other portions take its place. Circulation is thus set up and the whole system becomes heated. The rooms are then heated by radiation and convection from the pipes and radiators. Each radiator has a feed and a return pipe.

Explain the different systems of heating by steam and hot water. (1) In the direct system the radiators are placed in the rooms and furnish the heat direct; (2) in the indirect system the radiators are placed in the basement or another room in a sheet-iron box, fresh air is let in from the outside, warmed, and then conducted to the room; or (3) the radiators may be placed in the room, the fresh air brought in directly under them,

and, passing up between the pipes, warmed and distributed about the room. This might be called the direct-indirect system.

Where should radiators generally be located? Near the windows or doors or openings that supply ventilation, so the fresh air can be warmed somewhat as it comes in.

What is very necessary in heated dwellings, especially where stoves or hot-air furnaces are used? Sufficient moisture should be maintained in the air by the use of pans of water on the furnaces, stoves, or radiators.

What is a very necessary precaution where gas and coal furnaces are used? To see that there are no leaks in the pipes or furnace allowing the escape of illuminating or coal gas.

How is the heat of wards regulated? In some hospitals it is regulated automatically by valves which open up and let in heat when the ward gets below a certain temperature and close and shut off the heat when it gets above a certain temperature. Where there is no automatic device the thermometer in the room should be watched and the temperature regulated by turning the heat off and on as necessary or by opening or closing the doors and windows. Care should be taken that good ventilation be not sacrificed for the purpose of increasing the temperature. It is best to put more cover on the patients and let them have fresh air.

What precautions should be taken in lighting wards, sick rooms, and living spaces? Wards, sick rooms, and living spaces should have plenty of sunlight. Patients should not have to face the windows or lights, as the constant glare of the light is trying and disagreeable to the eyes. The light should come from their backs or sides, and the windows should have shades, in order properly to regulate the light.

What is the best artificial light? Electric lights; as they are in vacuums and give off no disagreeable odors or poisonous gases and consume none of the oxygen of the air. Lights should generally be placed high or shaded so as to prevent the direct glare in the eyes.

What are the chief objections to gas and oil lights? They consume much of the oxygen of the air in the process of com-

bustion; they often give off noxious gases and bad odors and vitiate the air; they are more trouble, and there is much danger of fires from them.

DISPOSAL OF WASTE.

Why is the proper disposal of waste so necessary? Because infection and disease are generally due to contamination from wastes, such as excreta from people and animals and organic refuse of all kinds which often contain bacteria of disease.

How is this contamination transmitted? By flies and various other insects and animals direct to persons or to the food and drink, or by direct contact of the person or food and drink with the wastes.

What are the principal wastes to be disposed of? Night soil (urine and feces), garbage and refuse food, slops, waste water, trash, etc.

How are wastes disposed of in cities and large towns? By systems of drain or waste pipes which empty into sewers and by crematories and dump heaps.

What wastes are disposed of by sewers and what by cremation? Night soil, slops, and waste water are disposed of by sewers, and solid organic matter, such as garbage, by cremation. Trash and inorganic matter are generally dumped in out-of-the-way places where trash is usually burned.

How are wastes disposed of in the country and villages? Night soil is discharged into pans, pits, or cesspools. When pans and pits are used the waste should be covered with earth, ashes, or lime. They are objectionable as they pollute the soil and scatter infection. Cesspools are excavations in the ground and may or may not have an impermeable lining; if they do not have this lining they are known as leeching cesspools. They are objectionable for the same reason as pits and pans. In some communities night soil is discharged upon the surface of the ground and scattered on the land for fertilizer. This is very objectionable and insanitary.

What is the final disposition of sewage? It is discharged into cesspools, into running streams or the sea, upon sewage farms, and into septic tanks.

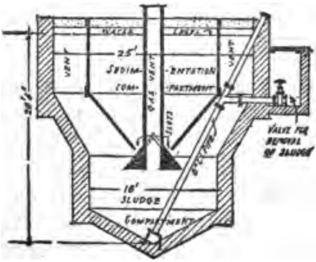

Fig. 74.—Imhoff sedimentation tank, sectional view. (Modern Hospital.)

What is a septic tank? It consists of two parts; a closed tank in which bacteria work in the absence of air and liquefy the organic matter, and a series of filter beds in which air-using bacteria continue the putrefaction until the sewage emerges as a clear liquid.

How are wastes disposed of on shipboard? At sea the disposal of waste is very simple, as everything goes overboard. On all ships there is a drainage system by which the night soil, slops, and waste water are discharged overboard, while the trash, garbage, and other refuse are thrown overboard. In port the trash, garbage, and refuse are placed on lighters or in receptacles on shore and disposed of by the local authorities.

How are wastes disposed of in field operations? Night soil in latrines and covered with earth; slops in pits and sterilized; trash, garbage, and other refuse are burned.

What is necessary in the drainage systems of houses and cities? That the plumbing should be good. There should be no leaks in the pipes and they should be well trapped so as not to allow any back flow of sewer gas or foul air into the dwellings.

FIELD HYGIENE AND SANITATION.

What are the requirements for a site for a camp or field hospital? It should be on high, well-drained ground with plenty of wood, water, and grass available, but the vegetation should not be very rank. The soil should be dry and pervious; old camp grounds should be avoided, as the soil is apt to be polluted; and so should clay and other impermeable soils, as they

retain water, make the air damp, and cause various catarrhal affections. The camp should not be placed near marshes or lagoons, but if this is unavoidable, it should be so located that the wind will not blow from them toward the camp.

What are some of the most necessary precautions to be taken when a site is selected? A guard should be placed over the water supply at once, separate places being designated for drinking and cooking and for bathing, washing clothes, and watering animals, and steps taken to turn the drainage away from it. Latrines should be dug at once at a considerable distance from and in the lee of the camp and where they will not pollute the water supply. The kitchen and kitchen pits should also be placed to leeward, but as far removed as practicable from the latrines. The ground should be cleaned up and all underbrush, weeds, and rank vegetation cut away for some distance around the camp.

What are some of the most necessary precautions in regard to tents? A good trench should be dug around each tent to keep out water. The walls should be kept triced up for proper ventilation, as tents are generally crowded, only about 80 cubic feet of air space being available for each occupant. About twice a week tents should be struck, removed to an adjacent area, turned inside out, and aired and sunned. The whole camp should be removed every 10 days or two weeks when practicable. Tents should have wooden floors if the camp is to be permanent, and these should be in sections in order that they may be removed two or three times a week and the ground cleaned under them. In the absence of wooden floors the ground should be well packed and covered with cinders, sand, or gravel. No food should be kept in any tents except the kitchen, mess, and store tents.

What necessary precautions should be observed in camp at night? A man should not sleep on the ground, but should use leaves, hay, straw, boughs, an improvised bunk, or his poncho. He should protect the abdomen well when asleep and use mosquito nets. The bedding should be aired daily if practicable.

What are the chief dangers of camp life? (1) Pollution of the water supply by excreta, dejecta, and other refuse of the camp. (2) Contamination of the food by dust, flies, ants, and other insects. (3) The spread of disease by mosquitoes, which are known to transmit malaria, yellow fever, and other diseases.

What precautions should be taken against flies? The camp should be kept clean; all refuse, garbage, etc., burned; excreta and dejecta covered up or disinfected, to prevent the breeding of flies or the transference of infection by them to the food or water supplies. The kitchen pits, kitchen, and mess tent should be well screened. The food and drink should be kept well covered, especially after cooking and boiling, to prevent contamination, as should also the dishes and kitchen utensils. A clean, well-ordered camp is the best protection against flies and other sources of infection.

What precautions should be taken against mosquitoes? Clear away the underbrush and rank vegetation for some distance from camp, drain or fill all stagnant pools to destroy the breeding places, or cover them and the ponds and swamps with petroleum to destroy the mosquito larvæ. Do not allow any vessels containing water to remain uncovered around the camp and clear away all broken bottles, tin cans, and other containers that act as breeding places.

Use screens wherever practicable and especially for the tents used as wards for the sick. When mosquitoes are very numerous and malaria is prevalent, it is best to give prophylactic doses of quinin to every one and active treatment to those infected until the disease is eradicated.

Describe the construction of latrines. They should be dug 2 feet wide, 10 to 20 feet long, and of varying depths, in accordance with the probable length of stay. The earth should be thrown to the rear and a stout pole placed lengthwise of the pit on forked uprights for a seat. When there is no natural screen, use canvas, boards, bushes, or brush for this purpose.

Describe the care of a latrine. Dejecta should be covered at once with a shovelful of earth by the person using the latrine, which should be inspected two or three times a day and covered

with a layer of a few inches of earth. Straw or paper saturated with kerosene should be burned in the pit once or twice a day.

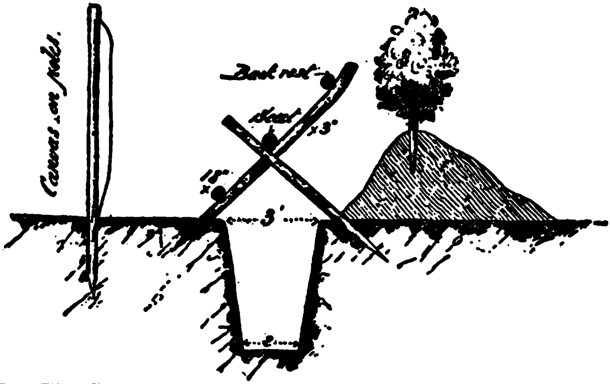

Fig. 75.—Construction of latrine for temporary camp. (Munson.)

Quicklime, when available, should be used to cover the dejecta, and the trench should be filled when within 2 feet of the top and when the camp is abandoned.

Urinals should be conveniently located, kept under surveillance, quicklimed frequently, and kept covered. Tubs, cans, or other vessels for this purpose should be placed in the company streets every night and removed, emptied, and cleaned in the morning.

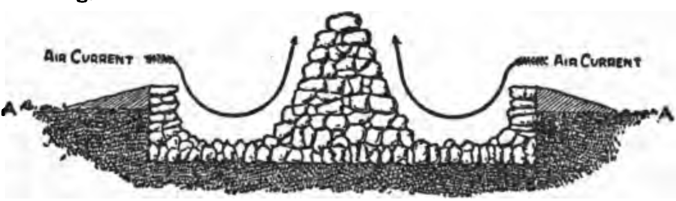

Fig. 76.—Crematory—vertical section. A A Ground level. (Mason.)

How would you dispose of kitchen refuse? The liquid refuse should be poured into pits near the kitchen. These should be

kept covered or screened to exclude flies, should be treated with kerosene once a day, and filled up when the camp is abandoned.

The solid refuse should be burned daily and a garbage incinerator should be constructed for this purpose if the camp is to be occupied for a lengthy period.

What other precautions are necessary in camp? Unless the water is known to be pure it should be boiled before drinking, the kitchen should be screened, the utensils and food containers kept perfectly clean, and the food protected from flies. The camp should be well policed, cleaned daily, and rubbish, etc., burned. The streets should be sprinkled daily when necessary to keep down the dust, which is not only disagreeable but spreads disease and infection. Milk and soft drinks should be treated with suspicion and overripe and unripe fruits forbidden. Raw foods are dangerous, but thorough cooking removes all danger of germ infection. Men should sleep under proper cover at night and not lie directly upon the ground. They should protect themselves with mosquito nets at night, and be careful about exposing themselves to the sun in summer and in the Tropics between the hours of 9 a. m. and 4 p. m.

What other precautions are necessary in camp life, as well as at other times, as regards the person, clothing, food, drink, and exercise? The clothes and person should be kept clean, and men should take a bath every day when practicable; the head and neck should be bathed twice a day and the hands frequently. They should take regular exercise by engaging in sports and practice marches, sleep and eat regularly, and avoid the use of alcoholic liquors. The clothing should be adjusted to meet the vicissitudes of service, as the body should be protected against the varying conditions of the weather.

How should a field hospital be located with reference to the general camp? It should be located apart from it so that the daily routine, drills, noises, and traffic of the camp will not disturb the sick or interfere with the work of the medical officers and assistants. The field hospital should be located and established on the same general principles as the general camp.

On account of the various diseases that have to be treated, the sanitary precautions should be very strictly enforced to prevent the spread of infection, and to this end antiseptics and disinfectants should be freely used, and all excreta, dejecta, refuse, waste, etc., disinfected or destroyed.

Give the general arrangement of a field hospital. The hospital or ward tents should be centrally located with the administration tent or office, operating and dispensary tents in front, the kitchen and commissary store tents in the rear, the officers' tents on one side, and the Hospital Corps' tents on the other side. The latrines, sinks, crematories, etc., should be placed well to the leeward away from the camp. The infectious wards or tents should be well removed from the rest of the tents and the same sanitary precautions observed as for the infectious camp and wards of a hospital. The arrangement of the field hospital will often depend on the character of the ground where it is located.

What is a very necessary precaution in regard to the hospital tents or wards? They, as well as the kitchen and food, should be well screened to keep out flies and mosquitoes and other insects and thus prevent their spreading infection. All feces, urine, and other excreta of patients should be treated with antiseptic solutions before disposed of, and dressings and other refuse should be burned.

ON THE MARCH.

Who should be excluded from expeditionary forces and landing parties? Men who have venereal diseases, deformed or sore feet, bad teeth, or diarrheal diseases, or men convalescing from disease or injury or not in robust health or who are very fat, and men under 20 or over 45 years of age, except in special cases.

What are the most necessary precautions to be taken on the march? Probably the most important consideration is the care of the feet, and the shoe is the most important single article of uniform. To avoid foot soreness, the first requisite is a prop-

erly shaped and fitted shoe, and the next is clean feet and clean, dry socks. The feet should be washed at the end of the march, the socks changed, and those taken off washed and dried, or at least sunned, for the next day. The toenails should be kept clean and cut square across, but not too short; corns should be kept trimmed close and blisters should be punctured at the lowest point, painted with iodin, and protected by adhesive plaster.

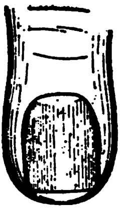

FIG. 77.—The correct way of cutting toenail to avoid ingrowing. Note relative sharpness of corners.

How would you treat soreness of the feet and excessive and foul sweating? Sore feet are very often due to excessive and foul sweating. This can often be prevented by washing the feet and dusting on them or into the shoe before marching the following powder: Salicylic acid, 3 parts; powdered starch, 10 parts; talcum, 87 parts; or by sprinkling a few drops of formalin into the shoe each morning. In severe cases soak the feet in a 1 to 6 per cent solution of permanganate of potash every night for two or three weeks, after washing them and using the dusting powder in the day. For soreness, vaseline or tallow as an ointment, especially between the toes, is very effective. The feet may be toughened by soaking them in strong, tepid alum water.

What other precautions are necessary on the march? If the sun shines warm, green leaves or a wet towel or handkerchief should be put into the top of the hat; the neck, arms, and legs should be covered to protect from sunburn; proper clothing should be worn to meet the varying conditions of temperature. The hair should be kept short and a bath taken every day when practicable. The head, neck, armpits, and genitals should always be bathed once a day or oftener.

How would you treat chafing and body vermin? Cleanliness is the best prevention for these. For chafing, bathe the part with salt water or some antiseptic solution, dry, and use vaseline or the foot powder. If infected with vermin, cut the hair

of the parts close and wash with 1/500 bichlorid solution or apply mercurial ointment.

What precautions should be observed in regard to drinking water on the march? This should be abstained from to a great extent. Boiled water may be drunk liberally at the start and the end of the march. The canteen should be filled with boiled water and thirst relieved by small quantities from it at intervals as necessary. Very cold or ice water should not be drunk, or if it is, it should be held in the mouth some time before swallowing.

PREVENTION OF DISEASE.

What relation do insects bear to disease? Disease may be transmitted through the bites of insects. This transmission may be biological, when the parasite causing the disease has to undergo a period of development in the body of the insect, or it may be mechanical, in which the infection is carried directly without any life cycle being passed in the insect.

Name some of the most important insects concerned in the spread of disease. Flies, mosquitoes, fleas, ticks, bedbugs, cockroaches, lice, and ants.

How do flies carry infection? They may transmit the virus of disease mechanically, either through their dejecta, when it may be scratched or rubbed into a wound made by the bite, or upon their mouth parts, legs, and other surfaces of the body. They may carry the infection directly to our lips or indirectly to our food or to any surface upon which they light.

To what general order do flies belong? Diptera. They are perhaps the most highly specialized of all insects.

Give a brief description of the life history of the house fly. This fly is known as the *Musca domestica*, and it passes from the egg to the adult stage in from 10 to 14 days. On an average 120 eggs are laid by a single female, and a generation is produced every 10 days at ordinary summer temperature. From this can be seen the possibility of a single female fly being responsible for countless millions of flies during a single season, and the necessity for the suppression of flies in the early spring is emphasized. The common house fly does not bite. A few

adults live over the winter in attics, etc., and when the warm weather sets in lay their eggs in manure or organic refuse. These eggs hatch into maggots, which later become pupæ and finally emerge as adult flies.

What is the chief breeding place of the common house fly? Horse manure. They also breed in human excrement, putrid or decaying animal or vegetable matter, in garbage, and in organic material of all kinds.

What is the best way to prevent the breeding of flies? This for the most part means striking at their breeding places, chiefly in horse manure and garbage. If practicable, stable manure should be placed in properly covered receptacles and removed at least once a week, and where it is not practicable to remove the manure it should be kept covered in a dark place, as flies desire light for breeding purposes. Garbage should be kept in cans with properly fitting covers and removed frequently. In addition, all refuse of an organic nature should be frequently removed.

If it is necessary to retain the horse manure as fertilizer, how may it be treated to prevent fly breeding and yet not destroy its fertilizing properties? The manure may be treated with either powdered borax or hellebore. Of powdered borax use 1 pound to each 16 cubic feet of manure (0.62 pound to 8 bushels) and apply it either in solution or scatter the borax on the manure and sprinkle well with water. With the hellebore a watery extract is made by adding one-half pound of the powder to each 10 gallons of water and, after stirring, allow to stand for 24 hours. This stock mixture is sprinkled over the manure at the rate of 10 gallons to 8 bushels. It is definitely proven that this latter method will prevent the breeding of flies and will not injure crops or chickens.

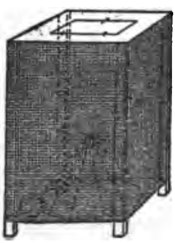

Fig. 78.—Fly trap. (Keefer.)

What methods are used to destroy flies? Flies may be killed by fly swatters, trapped with fly paper and mechanical traps, killed with pyrethrum or by fumigation with

sulphur, and by poisons placed around in open vessels. One of the best poisons is formalin in solution, 1 to 500, in sweetened water.

What is the best method of protection from flies? Living places, especially sick rooms and hospital wards, should be thoroughly screened, as should kitchens, dining rooms, mess halls, pantries, and provision storerooms, and all food should be very carefully screened and protected from flies. When flies get into a room or ward where there are contagious cases or infected material, they should be killed and not driven out, as they would then spread the infection.

What diseases do mosquitoes transmit? Malarial and yellow fevers, filariasis, and other diseases.

How do mosquitoes transmit disease? By biting an infected person or animal and then biting another person after a period of incubation.

What mosquitoes carry disease? Principally the *Anopheles maculipennis*, or malarial mosquito, and the *Stegomyia calopus*, or yellow-fever mosquito. Only the female bites, and therefore she alone conveys the disease. Mosquitoes generally bite at night, hence the necessity for protection against them at night. The stegomyia also bites in the day, and when mosquitoes are found biting in the day they are generally of that variety.

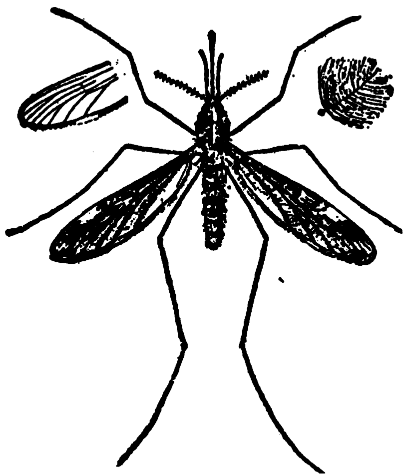

FIG. 79.—Anopheles maculipennis, a malaria-carrying mosquito. (Mason.)

How would you recognize a female anopheles or malarial mosquito? She is of a brownish color, her palpi are as long as

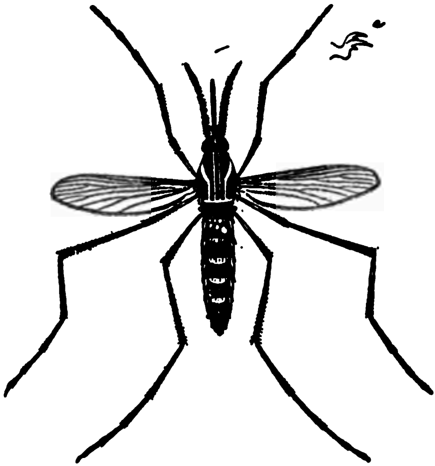

FIG. 80.—Female Stegomyia calopus. (Mason.)

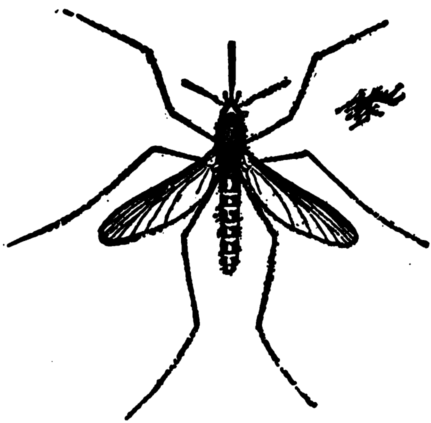

FIG. 81.—Culex, showing the short palpi, which distinguish from Anopheles. Toothed front tarsal claw at right. (Howard.)

her proboscis, her body and proboscis form a straight line, and when resting her body is nearly perpendicular to the surface on which she rests.

How would you recognize a female stegomyia or yellow-fever mosquito? She is very black and has white bands around the legs at the joints and around the after part of the body, and a white lyre-shaped figure on the back of the thorax or forward part of the body. Her palpi are shorter than her proboscis. She is humpbacked, and when resting her body is nearly parallel to the surface upon which she rests.

How do you distinguish male from female mosquitoes? Males have featherlike antennæ, or woolly heads, and females have not.

What are the habitats of mosquitoes? Yellow-fever mosquitoes breed in small collections of water around houses and do not go far from home, while the malarial-fever mosquito breeds in the country in large pools, streams, swamps, and ditches, and is found far away from human habitations.

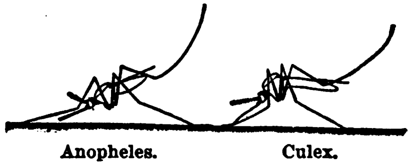

FIG. 82.—Resting positions of Anopheles and Culex mosquitoes. (Stitt.)

What is the incubation period for the malarial mosquito? A week or 10 days is required for the parasite to develop in the mosquito after biting an infected person. If the mosquito then bites a person, some of the parasites are injected into his

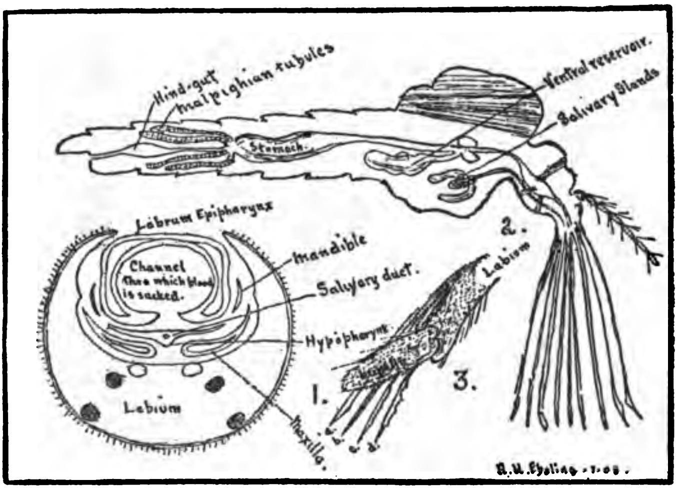

FIG. 83.—Anatomy of mosquito. 1, Cross section of proboscis; 2, anatomy of mosquito, longitudinal section; 3, tip of proboscis; a, labrum-epipharynx; b, hypopharynx; c, mandible; d, maxilla. (Stitt.)

blood, and after another period of incubation malarial fever develops.

What is the incubation period for the yellow-fever mosquito? The mosquito must bite a yellow-fever case within the first three days of the onset of the disease. The germ then develops

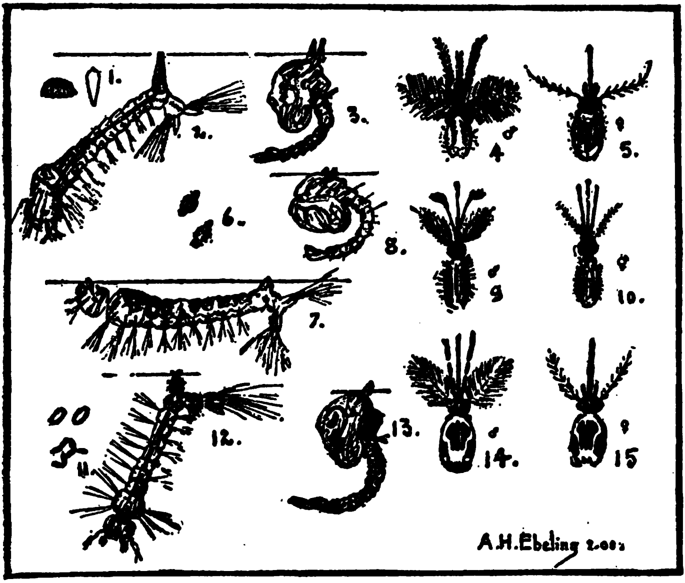

FIG. 84.—Metamorphosis of mosquitoes. 1, 2, 3, 4, and 5, Eggs, larva, pupa, and heads of male and female Culex; 6, 7, 8, 9, and 10, eggs, larva, pupa, and heads of male and female Anopheles; 11, 12, 13, 14, and 15, eggs, larva, pupa, and heads of male and female Stegomyia. (Stitt.)

in about 12 days and is transmitted to other victims by the mosquito biting them, and after an incubation period of from two to five days yellow fever develops.

How would you differentiate between yellow-fever and malarial mosquito larvæ? Malarial larvæ lie almost parallel to

the surface of the water, and yellow-fever larvæ hang nearly perpendicularly. The positions of the two larvæ are just the opposite of the adult mosquito when at rest.

What is the best protection against mosquitoes? Destruction of their breeding places, which are stagnant waters, and protection of those who have malarial and yellow fever from mosquitoes by screens. Where mosquitoes are present, all living spaces should be well screened, especially at night.

How are the breeding places of mosquitoes destroyed? By clearing away dense undergrowth and rank vegetation, and by draining or filling in all stagnant pools, ponds, ditches, lagoons, and swamps; and where this is impracticable, by covering their surface with a thin film of kerosene oil to destroy the larvæ and prevent breeding. All vessels or collections of fresh water around a house should be emptied, screened, or covered with kerosene.

How is disease transmitted by cockroaches, ants, etc.? Usually by contaminating the food and drink.

What are their principal habitats? Kitchens, galleys, pantries, dining rooms, mess halls, and any places where food is kept.

What is the best method for getting rid of them? By keeping their habitats clean and keeping food out of their reach. Fluorid of sodium is probably the most efficient exterminator of them. It should be blown into cracks, crevices, dead spaces, and the runways of the vermin with powder blowers, and put on the back part of shelves and in drawers and left there. It should be in a very thin film and be so distributed that the vermin will have to walk through it and get it on their legs. They clean themselves with their mouths, and thus are killed.

Why are fleas such a menace to health? Because several varieties of them have been proven to be concerned in the transmission of bubonic plague.

Where do fleas breed? Fleas deposit their eggs among the hairs of the host animal and the larvæ feed on almost any kind of refuse, even in cracks or in carpets in houses or in the nests or retreats of animals. They as a rule prefer certain hosts,

but those species which are best known and are associated with plague are found to attack several hosts, including man.

How do fleas transmit plague? Plague is primarily a disease of the rat and secondarily of man. There are other rodents that act as hosts for plague, as the ground squirrels, marmots, etc. The flea leaves the rat who has died of rat plague or may in some cases feed on man in the presence of living rodents. It is uncertain as to the exact way in which the disease is transmitted, but it is probably mechanical.

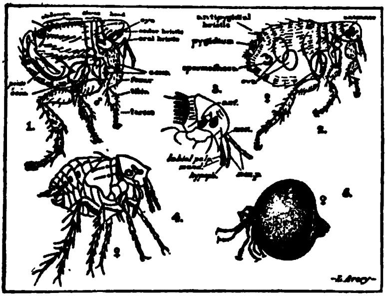

FIG. 85.—Types of fleas and jigger. 1 and 2, Male and female Xenopsylla cheopis; 3, head of Ceratophyllus; 4 and 5, male and egg, distended female of Sarcopsylla penetrans. (Stitt.)

What diseases are transmitted by ticks? The known diseases transmitted by ticks are Texas fever (tick fever), a disease confined to cattle; Rocky Mountain spotted fever, a disease of high mortality, affecting man, and closely resembling typhus fever; relapsing fever; and South African tick fever.

Where do ticks breed? The eggs are invariably deposited on the ground in large masses, and the adult ticks frequently hang tenaciously to the skin, in which they partly bury themselves.

How are ticks suppressed? If attached to the skin they will release their hold when covered with sulphur ointment. Ticks upon domestic animals may be controlled by dipping, spraying, or by hand methods.

What important disease is transmitted by lice? Typhus fever.

What are the three species of lice found upon man? Pediculus capitis (head louse), pediculus corporis (body or clothes louse), and pediculus pubis (crab louse). It is probable that only the first two are concerned in transmitting typhus fever.

What is the best method to destroy human lice? In most cases the prevention of lousiness is a matter of personal cleanliness. They may be destroyed by kerosene, turpentine, carbolic acid (1–50), and other insecticides. It is the egg that is most resistant to insecticides. To free the hair of lice rub the scalp well with a mixture composed of equal parts of kerosene and olive oil and cover the hair with a piece of muslin, this being done preferably before retiring. In the morning wash the scalp well with soap and hot water and use a fine-toothed comb dipped in vinegar. This should be repeated two or three times. In the case of body lice the experiences of the European conflict seem to prove conclusively that naphthalin is extremely efficient in eradicating these from large bodies of troops. It is cheap, does not interfere with service efficiency, requires no special apparatus, does not injure the clothing, and is absolutely not injurious to the health of the men. The method employed is to subject the clothes to steam disinfection, clip the hair from the bodies of the men, and follow this with a good soap and water bath. Upon coming out of the bath the disinfected clothes are put on again and the treatment with naphthalin begun. This consists in placing a handful of finely powdered naphthalin into the clothes, this being introduced through the neck opening. The patient sleeps in his clothes that night and the vapors from the evaporating naphthalin kill the lice and destroy the eggs. In order to be absolutely sure the treatment as outlined should be given twice

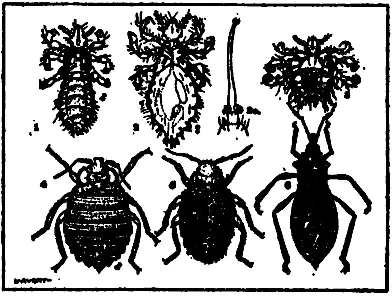

FIG. 86.—Types of lice. 1. Pediculus capitis. 2. Pediculus vestimenti. 2a. Protruded rostrum of Pediculus. 3. Phthirius pubis. 4. Acanthia lectularia. 5. A. rotunda. 6. Conorhinus megistus. (Stitt.)

more. For pubic lice white precipitate ointment or mercurial ointment should be used.

Are bedbugs known definitely to be concerned in the spread of disease? They are strongly under suspicion as carriers of many communicable diseases, as tuberculosis, leprosy, and other diseases.

How may bedbugs be eradicated? Bedbugs have the habit of concealing themselves beyond the reach of ordinary insecticides, and therefore special procedures are necessary. The most practical way of eradicating them is to introduce into all cracks and crevices, with a small brush or feather, gasoline, benzin, or kerosene; if, however, this is to be followed by sulphur fumigation, it is better to use a saturated solution of bichlorid of mercury in alcohol. This should be repeated until all signs disappear.

What are the eruptive fevers and what is the best mode of preventing their spread? They are measles, scarlet fever, smallpox, and chickenpox, and they should be isolated as soon as recognized to prevent their spread and all precautions carried out as described under infectious camps.

What other cases should be isolated? Mumps, whooping cough, erysipelas, cerebrospinal fever, bubonic plague, diphtheria, and some forms of tonsillitis. Tuberculosis, pneumonia, typhoid fever, typhus fever, epidemic poliomyelitis, influenza, malaria, yellow fever, dysentery, cholera, syphilis, and gonorrhea should be segregated. There is not the same necessity for strict isolation as in the other diseases mentioned, but the attendants should take just as strict antiseptic precautions and disinfect utensils, clothing, dejecta, etc., as in the eruptive fevers.

In what other ways are diseases transmitted? By rats, mice, and various domestic animals, and by direct contamination of the person, food, and clothing. Rats transmit plague; dogs and cats, rabies and various intestinal parasites; horses and cattle, glanders and anthrax; hogs, trichinosis, tapeworm, etc. Many diseases are transmitted by contamination of water and food, as typhoid fever, cholera, dysentery, diarrhea, and other

intestinal disorders. In many sections of the country, especially in the Southern States, the hookworm is very prevalent in the soil and is transmitted by contact with infected dejecta and soils.

How is tuberculosis generally contracted? By association with tuberculous cases and by insanitary surroundings.

What precautions should be taken to prevent the spread of tuberculosis? Tuberculous cases should be segregated and association with them avoided. They should have a mild, equable climate and live in the open air as much as possible. Their sputum should always be disinfected, as should their dejecta and clothing, tableware, and utensils.

What are the cardinal points in preventing the spread of infection? (1) The patient should be isolated and screened; (2) the attendants should observe strict antisepsis; (3) all the excreta, dejecta, dishes, utensils, clothing, etc., should be disinfected; (4) when discharged the patient and his effects should be disinfected; (5) the room or ward and furniture should then be fumigated.

What diseases can be prevented or cured by vaccines and serums? (1) Smallpox is prevented by vaccination, which was discovered by Edward Jenner in England and made known in 1798; (2) diphtheria is prevented and cured by hypodermic injections of antitoxin which is the serum of a horse immunized to diphtheria; (3) rabies is prevented by the injection of broth made from the spinal cords of infected rabbits; (4) tetanus is prevented and sometimes cured by injections of tetanus antitoxin; (5) typhoid fever is prevented by injecting killed cultures of typhoid bacilli; (6) cerebrospinal fever is often cured by Flexner's serum; (7) pneumonia, erysipelas, septicemia, boils, and gonorrhea are often treated and cured by vaccines made from their respective bacteria.

What is quarantine? The word is derived from the Italian word *quaranta*, meaning forty, it being the custom in remote times to detain arriving ships with cases of disease for a period of 40 days. There are many kinds of quarantine, as maritime, house, etc. In its broadest sense, when we speak of quarantine

we refer to maritime quarantine, which is controlled by the Federal authorities and is defined as the detention for certain periods of time, with denial of privilege of entering the country, of ships, persons, animals, or goods that are infected with certain contagious diseases or that have arrived from ports which are infected with any of these diseases.

Upon what is the period of detention based? Upon the usual period of incubation for each disease, that period which intervenes between the exposure to a disease and the manifestation of symptoms of that disease.

What diseases are quarantined by the Public Health Service and what are their quarantine periods? (1) Cholera, 5 days; (2) yellow fever, 5 days as a precautionary measure and 6 days if a case has developed aboard; (3) bubonic plague, 7 days; (4) typhus fever, 12 days; (5) smallpox, 14 days; (6) leprosy, if an alien and afflicted with leprosy, not allowed to land and the vessel upon which he arrived must take him back again on return voyage; if a citizen of the United States, he is handled by the laws of the city or the State in which he finds himself.

DISINFECTION.

What is meant by disinfection? Disinfection means the destruction of the agents causing infection. It does not include the destruction of all the lower forms of animal and vegetable life—this is sterilization.

What is antisepsis? Antisepsis means preventing or retarding the growth and activity of organisms but does not necessarily include their destruction.

How is disinfection accomplished? (1) By dry heat—150 C. for one hour will destroy all forms of life. This is little used as it lacks penetrating power and is injurious to most fabrics; (2) by boiling—an exposure to boiling water at 100 C. for one hour will destroy practically all disease-producing organisms with which we come in contact; (3) by steam heat—this includes both streaming steam and steam under pressure. Streaming steam has same disinfecting power as boiling water, and

steam under pressure is even a more powerful germicide. The usual standard of steam under pressure is a pressure of 15 pounds to the square inch and continued for 20 minutes resulting in absolute sterilization; (4) by various chemical agents—this includes both gaseous disinfectants and chemical solutions.

What are the principal disinfectants used in the form of chemical solutions? (1) Bichlorid of mercury, commonly called corrosive sublimate, used in strength of 1/500 to 1/1000, depending upon whether or not spores are present, and exposure continued for one hour. It has the disadvantage of being injurious to metals, is highly poisonous, fixes stains in soiled fabrics, and can not be used to disinfect any material containing albumin, as this forms a coagulum with and prevents further penetration of the bichlorid. It therefore can not be used for the disinfection of sputum and feces. (2) Carbolic acid (phenol), used in strength of 2.5 to 5 per cent but is not to be depended upon to kill spores. It does not coagulate albuminous matter and is not destructive to fabrics and metals in the strengths used for disinfection. Other members of the phenol group are also used for disinfecting purposes, as cresol, tricresol, and lysol, all used in the strength of 1 per cent. (3) Formalin. This is a solution of formaldehyd (37.5 per cent by weight) in water, but when speaking of a certain strength solution of formalin to be used as a disinfectant we regard formalin just as we do carbolic acid, and if for instance we wished to make a 1 per cent solution of formalin we would add one part of formalin in the proportion of 1 to 100. This also does not coagulate albuminous matter, is not injurious to most articles, is not very poisonous, and is a true deodorant. It is used in the strength of 5 per cent as a disinfectant, but it is perhaps safer when one realizes the tendency of the solution to deteriorate with age to use a 10 per cent solution if organic matter is present. (4) Chlorinated lime. This is somewhat unstable owing to its affinity for water, the absorption of which renders it inert as a disinfectant. If fresh it should have a very slight odor of chlorin, a strong odor indicating that deterioration is taking place. It may be used either as a dry

powder or in solution, in either case sufficient being used to make a 4 per cent solution and kept in contact for one hour. It has distinct bleaching powers, is destructive to fabrics, but is an excellent deodorant.

What are the principal gaseous disinfectants? (1) Formaldehyd. This gas is a very efficient germicide, though only effective as a surface disinfectant; it does not injure fabrics, is not highly poisonous, is valueless as an insecticide, and fails to kill vermin such as rats, mice, roaches, etc. (2) Sulphur dioxid. This gas while moderately efficient as a germicide is destructive to all forms of animal life; it is only a surface disinfectant, bleaches and rots fabrics, and is highly injurious to most metals. (3) Hydrocyanic gas. This is perhaps one of the most efficient methods that can be employed to exterminate vermin from ships, but its use is limited to experienced hands by reason of its extreme toxicity.

How do you generate formaldehyd gas for fumigation in disinfecting rooms? There are various ways, as by liberating the gas from wood alcohol by heating in a special generator, by the use of autoclaves, by vaporizing with heat solid paraform pastils, etc., but these have all been largely replaced in the service by the simple and inexpensive formalin-permanganate method. By this method there are poured 500 mils of formalin onto 125 grams of potassium permanganate for each 1,000 cubic feet of space. Place in a metal receptacle the required amount of potassium permanganate and set this in a tub or large pan partly filled with water and pour the required amount of formalin upon the permanganate; the gas will begin to generate in a few seconds. It should be remembered that there is a tendency to foam over the sides, thus soiling the floor and perhaps increasing the danger of fire, and receptacles should be large enough to prevent this. It is also better when fumigating a large space to divide the

FIG. 87.—Container for generating formaldehyd gas. (Formaldehyd-potassium permanganate method.) (Mason.)

amount of each ingredient used and distribute the process in two or more parts of the compartment. The following method used by the New York Department of Health has proven extremely efficient: For each 1,000 cubic feet of space mix in a large pan 30 grams paraformaldehyd and 75 grams potassium permanganate, and 90 mils of water, and stir well. The gas is evolved slowly but is complete in 10 minutes. The same precautions are to be used as in the preceding method. In whatever method used the formaldehyd gas should remain sealed in the room for from 6 to 12 hours.

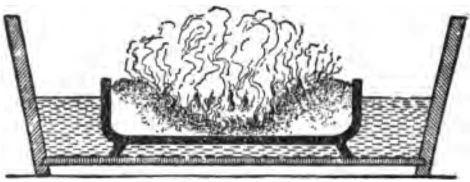

FIG. 88.—Burning sulphur. (Mason.)

How is sulphur dioxid generated for purposes of fumigation? Five pounds of sulphur are required for each 1,000 cubic feet of air. Break up the sulphur well, place it in a pan, and pour a small quantity of alcohol over it. The pan is then placed on bricks in a tub of water, the alcohol ignited, the room closed, and left from 4 to 12 hours before opening. Bright metals should be removed or coated with carbolated vaseline, as sulphur tarnishes them badly.

Describe the hydrocyanic gas method of fumigation? The gas is generated by the action of sulphuric acid on sodium cyanid in the presence of water, using for each 1,000 cubic feet of space 3¾ ounces of sodium cyanid, 5½ fluid ounces of sulphuric acid, and 7½ fluid ounces of water. It is absolutely necessary, in addition to having a trained corps of assistants, to first go over the ship or area to be fumigated and map out carefully the route to be followed, as the generation of the gas in a compartment must be followed by a rapid exit, and extreme care must be taken that any space already containing the gas is not passed through again. The actual distributors of the gas ingredients should be outfitted with oxygen respirators

for use in case they are trapped in the cyanid fumes, although it is the belief that if the course is properly mapped out and rehearsed the use of these respirators will not be necessary. The acid will first be mixed with the water, and, where the area to be fumigated is a large one, this had best be done in large barrels, care being taken to pour the acid slowly into the water and constantly stir the mixture. The solution is then placed in paraffined buckets (a 3-gallon bucket will serve for 10,000 cubic feet of space), in varying quantities, but a check kept on the amount each bucket contains. The buckets are then distributed, the required amount of cyanid in the meanwhile having been measured out for each bucket, placed in paper bags, and placed beside the designated bucket, and all assistants cautioned not to mix the two until so ordered. A final inspection is made to see that the distribution is according to the mapped-out plan, that the proper doors and hatches can be opened as scheduled, and that all persons are out of the area to be fumigated. When satisfied as to this, the fumigation is started, and merely consists in placing the bags of cyanid (not emptying) in the acid, immediately leaving the compartment and closing the door of exit. When completed, the space should remain closed for 14 hours. At the end of this time, if a ship, it should be opened by first reaching the blower switch and starting the ventilating system, and in other cases reaching some area of exit and opening this. Oxygen respirators should be used by those who are detailed to do this work. Four to six hours should elapse after the space is opened before the danger from cyanid fumes can be regarded as having passed, and no one should be allowed to occupy the space before this. The gas appears to be harmless to all materials, has deep penetration, embodies no fire risks, is extremely efficient against animal life, and has no tendency to linger in the compartment or clothes. Cool weather retards the reaction and very cold weather may absolutely prevent it, so that occasionally the water added should be warmed first.

After fumigation what steps are to be taken? Open up the room from opposite sides so it can be ventilated and the fumes

gotten rid of; put the clothing and bedding out to air; then scrub the floor, walls, ceiling, and furniture with an acid bichlorid solution.

Which is the more efficient disinfectant, sulphur or formaldehyd gas, and why? Sulphur is the more efficient as it destroys vermin, insects, and the higher forms of life as well as bacteria, while formaldehyd gas destroys only bacteria.

What objections are there to the use of sulphur? It blackens metals and injures certain fabrics and destroys colors.

How would you disinfect mattresses, pillows, and thickly padded articles? By steam sterilization, as fumigation only disinfects surfaces, and would not penetrate these articles sufficiently.

Describe the operation of a steam disinfector. The mattress and other articles should be placed in the chamber from the infected side and the doors tightly closed. The steam should be turned into the jacket to heat up the chamber, and the vacuum valve should be opened to exhaust all the air in the chamber, after which it is closed and steam under 15 or 20 pounds' pressure turned into the chamber for 20 minutes, then exhausted, air let in, and the articles dried by the heat from the jacket of the chamber and then removed by the noninfected side.

How would you sterilize clothing and other fabrics with antiseptic solutions? They should be placed in an appropriate vessel, covered with the solution, and allowed to stand from two to four hours.

What precautions should be taken with bichlorid of mercury solution? It should never be used in metallic vessels nor on metallic instruments, utensils, or apparatus, as it corrodes them and would render them useless in a short while.

What are the best antiseptic solutions for metallic articles? Phenol, or carbolic acid, and cresol.

EMBALMING.

Describe embalming. It is frequently impracticable and often impossible to obtain the services of a competent civilian

embalmer, and in such cases the full responsibility for properly embalming a body will always fall on the Hospital Corps. The keynote of successful embalming lies in knowing the proper fluid to use, the proper amount of this to use, the proper locations in which to inject it, and the proper way in which it should be injected. Each of these will be discussed separately.

Embalming fluid.—There is an embalming fluid which was devised at the Hygienic Laboratory of the Public Health Service which has stood repeated tests and has proven effective in preserving human subjects exposed for two months at a temperature of 98 F. It has the further advantage of containing ingredients all of which are almost always found on every ship and station. The formula for this is:

Formalin, 12.50 mils.
Borax (sodium borate), 5 grams.
Water sufficient to make 100 mils.

It is necessary that the formalin be official strength; if below this, the amount must be proportionally increased. Formalin itself is the usual basis for most commercial embalming fluids, but when used alone it tends to bleach the tissues to an ashen gray, and this is overcome by adding an alkali, sodium borate being considered the best, as it does not, like some other alkalis, cause the formalin to deteriorate after standing, and, in addition, is itself a preservative.

Amount.—There should be injected a quantity of embalming fluid equal to 15 per cent of the body weight, considering a pound equal to 493.59 mils. It is a simple matter to inject too large a quantity and, while this will in no way lessen the preservation of the body, it will cause a puffy and unnatural appearance of the face and hands which should be avoided where possible.

Location in which to inject.—To get a uniform distribution of the fluid it is usually necessary to make six injections, as follows: Of the amount used (15 per cent) inject into each brachial artery toward the fingers, 1 per cent; into each femoral artery toward the toes, 2 per cent; into one common carotid artery toward the head, 2 per cent; into the same common

carotid artery toward the heart, 7 per cent. If this is not followed, there is the chance that some parts of the body will receive but little, if any, fluid and will therefore soon show signs of decay.

Method of injection.—An excellent apparatus is simply a 3-gallon bottle fitted with a rubber stopper through which pass two glass tubes, one extending to the bottom of the bottle which serves as an outlet for the fluid and has attached to it outside of the bottle a rubber tube in the free end of which is a glass cannula for insertion into the blood vessel, and another glass tube connected by rubber tubing to a pump of some kind (as a bicycle pump, etc.), which serves solely to supply air under pressure for the purpose of forcing the fluid out of the other tube. There should be marked on the bottle, preferably with strips of adhesive, the amount of the contained fluid that is to be injected into each artery. When all preparations are made the blood vessels as mentioned are exposed, and the fluid injected as outlined. It is not considered necessary before injecting the fluid to draw the blood from the veins, though there is no objection to this, and it is furthermore not necessary to inject the fluid into the cavities of the chest, abdomen, or skull, except in certain necropsied cases. Where one has had practice in embalming it is often a simple matter to discern when a sufficient amount of fluid has been injected by noting the return of fluid through the veins, but it is safer for the beginner to adhere rather closely to the amounts given. The anus, mouth, and nostrils should be plugged with cotton soaked in embalming fluid, and the entire body, including face, ears, and hair, washed with the fluid. If it is desired to keep the body for a great length of time, drying can be prevented by rubbing vaseline liberally over the entire body, followed by bandaging. If while injecting the fluid into the common carotid artery the eyes, lips, or the side of the face become overdistended, the injection at that site should cease.

To locate the brachial artery make an incision along the inner margin of the biceps muscle at about the middle of the arm, cut the fascia over the top of the blood vessels, determine the artery,

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and incise lengthwise through its coats sufficient to insert the cannula. To locate the femoral incise anywhere along its course, which is a line drawn from the middle of Poupart's ligament to the junction of the middle and lower third of the thigh on the inner side, but preferably at the lower part. Proceed as in the case of the brachial. To locate the common carotid artery have the head thrown back and turned slightly to the side opposite to the side on which you inject; incise along the anterior border of the sternocleidomastoid muscle with the center of the incision at about the level of the Adam's apple, and proceed as in the case of the brachial. In all cases when sufficient fluid has been injected into a particular blood vessel, withdraw the cannula and sew up the incision into the blood vessel as well as that in the skin.

CHAPTER 9.

PHARMACY.

What is pharmacy? Pharmacy is the science which treats of medicinal substances and the art of preparing and dispensing them.

Into what two great classes is pharmacy divided? Theoretical and practical.

What is theoretical pharmacy? A knowledge of the substances used as medicines—animal, vegetable, and mineral, comprising *botany*, the science of plants; *mineralogy*, the science of inorganic substances; *zoology*, the science which treats of animals; *physics*, the science which explains the changes produced in bodies without changing their identity; *chemistry*, the science which treats of those changes affecting specific identity of the bodies; *materia medica*, the medicinal materials or substances used as medicine; *pharmacognosy*, the science of crude drugs; *toxicology*, the science of poisons; *microscopy*, the art of examining the minute structure of bodies by the aid of artificial lenses arranged for magnifying; *bacteriology*, the science which treats of microorganisms.

Of what does practical pharmacy treat? The operations, processes, and methods used in applying the principles of theoretical pharmacy.

What is a pharmacopeia? An authoritative list of medicinal substances, with definitions, descriptions, and formulas for their preparation. The United States Pharmacopeia is revised every 10 years by a committee appointed from the professions of medicine and pharmacy. The drugs and preparations which it contains are recognized as official.

How are the titles of the medicinal substances indicated in the United States Pharmacopeia? (1) By the official Latin

[illegible]

[illegible] examples of each: [illegible] official name: [illegible] [illegible] English name; Indian name [illegible]. [illegible] [illegible] [illegible] symbolic formula [illegible] [illegible] [illegible] [illegible] [illegible] name.

Why should the official Latin title be used? The official Latin title should be used in designating the drug when precision is required—when prescriptions, specimens, etc.

Why is the Latin language employed? Because it is a dead language and not likely to change, as in the case of a living language, and because it is understood the world over.

When should the official English title be used? In ordinary conversation, in commerce, [illegible], etc.

What is the botanical name? The systematic name recognized by botanists for plants.

What is the symbolic formula? The symbolic formula is a combination of symbols representing the chemical structure of the substance to which it refers.

What is the official definition? The official definition states explicitly what kind or variety of the substance should be used.

What is meant by the purity rubric? It fixes the standard of purity required by the Pharmacopeia, and the limit of harmless impurities permissible.

What is the official description? The official description follows the official definition in the Pharmacopeia. It consists of, in drugs: A concise statement of physical characteristics, tests of identity, and description of adulterants. In chemicals: Statement of physical characteristics, solubilities, tests of identity and purity.

What is to be said of assay processes? The assaying of drugs and preparations has become necessary in order definitely to fix their value as medicinal agents.

What doses are given in the United States Pharmacopeia? The average approximate (but within a minimum or maximum)

dose for adults, the metric system to be used, and the equivalents in apothecary's weights or measures appended.

What is a dispensatory? It is a commentary on a pharmacopeia. It aims to present information concerning important nonofficial drugs and those official in other pharmacopeias, as well as those in the United States Pharmacopeia.

METROLOGY.

What is metrology? The science of weights and measures.

What is weight? Weight is the difference between the attraction of the earth and that of surrounding bodies for bodies on the surface of the earth.

What is meant by weighing? Balancing a body of known gravitating force with one whose gravity is not known for the purpose of estimating the gravitating force of the latter, which is called its weight.

What are weights? Weights are bodies of known gravitating force used for weighing.

What name is given to the apparatus used for weighing? Scales and weights.

What is measure? The bulk or extension of bodies.

What systems of weights and measures are in general use in this country? Avoirdupois weight, used in commercial buying and selling; troy weight, used by jewelers for weighing jewels and precious metals; apothecaries weight, used by pharmacists in compounding; apothecaries fluid measures; and the metric system of weights and measures.

What are the units of weight, and how were they obtained for these different systems? For apothecaries, troy, and avoirdupois weights the unit is the grain, which was established by a decree of King Henry III, of England, in the year 1266—"An English silver penny, called the sterling, round and without clipping, shall weigh 32 grains of wheat, well dried and gathered out of the middle of the ear." About 200 years later the weight of the sterling was reduced to 24 grains, and so remains to-day. The unit of weight in the metric system is the gram (or gramme), and was obtained from the meter, the unit

of linear measure; 1 milliliter (cubic centimeter) of distilled water at 4 centigrade weighs 1 gram.

What are the symbols of each? Apothecaries; grain, or grains, gr.; scruple, ℈; dram, ʒ; ounce, ℥. Avoirdupois: Ounce, oz.; pound, lb.

How many grains does an ounce of each system contain, and what is the difference in grains between the apothecaries and avoirdupois ounce? Avoirdupois ounce=437½ grains; apothecaries ounce=480 grains. An apothecaries ounce weights 42½ grains more.

What is the difference in grains between the avoirdupois and apothecaries pounds? Avoirdupois pound, 7,000 grains; apothecaries pound, 5,760 grains. Avoirdupois pounds, therefore, weighs 1,240 grains more.

Recite the tables of weights and measures in general use.

Tables of weights and measures.

ENGLISH SYSTEMS.		METRIC EQUIVALENTS.
Avoidupois weight::		
1 grain	gram	0.065
437.5 grains make 1 ounce (oz.)	grams	28.35
16 ounces make 1 pound (lb.)	do	453.60
100 pounds make 1 hundredweight (cwt.).		
20 hundredweight make 1 ton.		
Apothecaries weight:		
1 grain	gram	0.065
20 grains make 1 scruple (℈)	grams	1.30
3 scruples make 1 dram (ʒ)	do	3.90
8 drams make 1 ounce (℥)	do	31.103
12 ounces make 1 pound	do	373.236
Troy weight:		
1 grain	gram	0.065
24 grains make 1 pennyweight (dwt.)	grams	1.555
20 pennyweights make 1 ounce	do	31.103
12 ounces make 1 pound	do	373.236
Apothecaries measure:		
1 minim (0.95 grain) (♏)	mil	0.06
60 minims make 1 fluidram (fʒ)	mils	3.70
8 fluidrams make 1 ounce (f℥)	do	29.57
16 fluidounces make 1 pint (O)	do	475.18
8 pints make 1 gallon (Cong.)	do	3,785.40
(One gallon contains 231 cubic inches. One fluidounce of distilled water weighs 454.6 grains at 25 C.)		
Long measure:		
1 inch	millimeters	25.4
12 inches make 1 foot	centimeters	30.48
3 feet make 1 yard	meters	0.914
5.5 yards make 1 rod (or perch).		
40 rods make 1 furlong.		
8 furlongs make 1 mile	do	1,609.35

METRIC SYSTEM.		ENGLISH EQUIVALENTS.
The unit of length (or linear measure) is the meter, obtained by calculating one forty-millionth of the circumference of the earth around the poles.		
Length:		
Kilometer, 1,000 meters	mile	5/8
Hectometer, 100 meters.		
Decameter, 10 meters.		
Meter (unit)	inches	39.37
Decimeter, one-tenth meter	do	3.937
Centimeter, one-hundredth meter (cm.)	inch	2/5
Millimeter, one-thousandth meter (mm.)	do	1/25
Capacity:		
Kiloliter, 1,000 liters.		
Hectoliter, 100 liters.		
Decaliter, 10 liters.		
Liter (unit), cube of one-tenth meter	fluidounces	33.814
Deciliter, one-tenth liter	do	3.3814
Centiliter, one-hundredth liter	fluidounce	1/3
Milliliter, one-thousandth liter (mil) (formerly cubic centimeter)	minims	16.23
Weight:		
Kilogram, 1,000 grams	apothecaries ounces	32.15
	avoirdupois ounces	35.27
Hectogram, 100 grams.		
Decagram, 10 grams.		
Gram (unit) weight of 1 mil distilled water at 4 C.	grains	15.432
Decigram, one-tenth gram	do	1.5
Centigram, one-hundredth gram	grain	1/6
Milligram, one-thousandth gram	do	1/65

What is the metric system? The metric, French, or decimal system of weights and measures originated with Prince de Talleyrand, Bishop of Autun, France, in 1790, and has been legally adopted by the majority of all civilized nations. It is based on the meter, the unit of linear measure, and from which all the other units are derived.

How was this unit derived? By calculating one forty-millionth of the circumference of the earth around the poles and naming it one meter.

What is it practically? Practically, it is the length of certain carefully preserved bars of metal from which copies have been taken.

What is its equivalent in feet and inches? It is equal to about 3 feet 3 3/8 inches.

What is the unit of surface and how it is derived? The unit of surface is the are, which is the square of 10 meters (the square of a decameter), a square whose side is 11 yards.

What is the unit of capacity and how is it derived? The liter, which is equivalent to the volume occupied by the mass of 1 kilogram of pure water at its maximum density (4 C.). It is equivalent in volume to 1.000027 cubic decimeters, 2.1134 pints.

What is the unit of weight and how is it obtained? The unit of weight is the gram, which is the weight of 1 milliliter of distilled water at its maximum density (4 C.), 15.43235 grains, or about 15½ grains.

What are the denominations of the metric system, multiplied and divided? They are multiplied by the Greek words, *deca,* ten; *hecto,* hundred; *kilo,* thousand; and divided by the Latin words *deci,* one-tenth; *centi,* one-hundredth; *milli,* one-thousandth.

Give a table showing how metric units are multiplied and divided.

Quantities.	Length.	Surface.	Capacity.	Weight.
Units.				
1,000	Kilometer.......	....	Kiloliter.........	Kilogram.
100	Hectometer......	Hectare..........	Hectoliter.......	Hectogram.
10	Decameter.......	....	Decaliter........	Decagram.
1	Meter............	Are.............	Liter............	Gram.
.1	Decimeter.......	....	Deciliter........	Decigram.
.01	Centimeter......	Centare.........	Centiliter.......	Centigram.
.001	Millimeter.......	....	Milliliter........	Milligram.

What is the use of the gram and of the milliliter as units of weight and measure? The gram and its divisions are used for weighing and the milliliter (mil) for measuring liquids. A gram and a milliliter of distilled water are the same, but owing to greater or less density milliliters of other liquids weigh more or less than a gram, as the case may be. If the mil is taken as a unit of capacity only, and the gram as the unit of weight, all difficulty is avoided. Dissolve 1 gram of salt in q. s. water to make 10 mils. Each mil of this solution contains 1 decigram of salt. By keeping the mil intact and varying the strength of the solution, each mil can be made to contain any stated amount of salt from saturation to an infinitesimal quantity.

Give the table of equivalents (metric and apothecaries).

One milliliter	16.23	minims.
Four milliliters	1.08	fluidrams.
Thirty milliliters	1.01	fluidounces.
One minim	0.06	milliliter.
Four minims	.25	milliliter.
Ten minims	.62	milliliter.
One apothecaries dram	3.888	grams.
One apothecaries ounce	31.103	grams.

What is the signification of the micromillimeter and the kilo? The micromillimeter (mkm, or micron) is a term used in microscopy, and signifies the one-thousandth part of a millimeter. Kilo. is an abbreviation of the word kilogram, and is used for convenience and brevity.

How are metric weights and measures converted into those in ordinary use? Multiply the metric quantities by the corresponding equivalent. Example: To convert—

Meters into inches	multiply by	39.370
Liters into fluidounces	do	33.815
Milliliters into fluidounces	do	0.0338
Grams into grains	do	15.432
Decigrams into grains	do	1.5432
Centigrams into grains	do	.15432
Milligrams into grains	do	.015432

How are weights and measures in ordinary use converted into metric weights and measures? Multiply the quantities by the corresponding metric equivalent. Example: To convert—

Inches into meters	multiply by	0.0254
Fluidounces into milliliters	do	29.572
Grains into grams	do	0.0648
Avoirdupois ounces into grams	do	28.3495
Apothecaries ounces into grams	do	31.1035

What are approximate measures of ordinary containers? A tumblerful, f ℥ viij (240 mils); a teacupful, f ℥ iv (120 mils); a wineglassful, f ℥ ij (60 mils); a tablespoonful, f ʒ iv (16 mils); a dessertspoonful, f ʒ ij (8 mils); a teaspoonful, f ʒ i (4 mils).

What is a balance? An instrument for determining the relative weight of substances.

How many kinds of balances are there? There are five kinds: (1) Single beam, equal arm; (2) single beam, unequal arm; (3) double beam, unequal arm; (4) compound lever balances; (5) torsion balances.

How are balances protected? By inclosing them in glass cases with convenient sliding doors.

How are liquids measured? In graduated vessels of glass, tinned copper, or other metals, graduated on the sides.

What is the size of a drop? A drop will vary greatly in size. Thick, viscous liquids produce large drops; heavy, mobile liquids small ones. A drop of a heavy sirup may be five times greater than a drop of chloroform. The shape or surface of the receptacle from which a drop is poured causes appreciable difference in size.

SPECIFIC GRAVITY.

What is specific gravity? The comparative weight of bodies of equal bulk, ascertained by weighing the bodies with an equal bulk of pure water at a given temperature and atmospheric pressure, which is expressed as one (1. or 1.000).

SPECIFIC VOLUME.

What is specific volume? The volume of one body compared with the volume of an equal weight of another body selected as its standard, both bodies having the same temperature. Directly opposite to specific gravity; temperature chosen usually 25 C. (77 F.).

What is a thermometer? A thermometer consists of a glass tube with capillary bore sealed at one end and the other end terminating in a bulb. The bulb is filled with mercury or other fluid which, being expanded by heat, rises in the tube and registers the degree of heat, either on an index scratched on the tube or marked on a piece of paper (separated scale) placed on the side of the tube.

How many different scales for marking thermometric degrees are now in general use? Three. Centigrade, Fahrenheit, and Réaumur. In the centigrade scale the freezing point of water is zero, the boiling point 100°, and the intervening space is divided into 100 equal parts called degrees. In the Fahrenheit scale the freezing point of water is 32°, the boiling point 212°, and the intervening space is divided into 180 equal parts called degrees. In the Réaumur scale the freezing point is zero and the boiling point 80°.

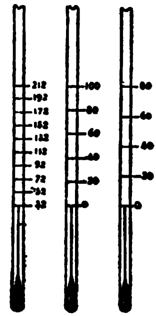

FIG. 89.—Thermometers; from left to right, Fahrenheit, Centigrade, Réaumur. (Remington.)

What ratios do the three scales bear to each other, and how is one scale converted into another? Ratio, C. 5 : F. 9 : R. 4. To convert centigrade degrees into those of Fahrenheit above 32, multiply by 1.8 and add 32. To convert Fahrenheit degrees above 32 into those of centigrade, subtract 32 and divide by 1.8.

What processes in pharmacy require the application of high heat? (1) Ignition, (2) fusion, (3) calcination, (4) deflagration, (5) carbonization, (6) torrefaction, (7) incineration, (8) sublimation.

Describe each. Ignition consists in strongly heating solid or semisolid substances with access of air to obtain a definite residue. Example: The official quantitative tests for potassium bitartrate, sodium benzoate, etc.

Fusion is the process of liquefying solid bodies by the application of heat without the use of a solvent. Example: Melting of wax, lead, or preparation of molded silver nitrate.

Calcination is the process of driving off volatile substances, such as water or CO_2 from inorganic matter by heat without fusion. Example: Magnesium oxid and calcium oxid prepared from their carbonates by calcination.

Deflagration is the process of heating one inorganic substanee with another capable of yielding oxygen (usually a nitrate or a chlorate). Decomposition ensues, accompanied by a violent,

noisy, or sudden combustion. Example: Salts of As and Sb made by this process.

Carbonization is the process of heating organic substances without the access of air until they are charred. The volatile products are driven off, but combustion is prevented. Example: Charcoal is made in this way.

Torrefaction is the process of roasting organic substances. The constituents are modified but not charred. Example: The roasting of coffee. Torrefied rhubarb is obtained in this way. It loses its cathartic properties by this process, but retains its properties as an astringent.

Incineration means the burning of organic substances to ashes in air. The ash is the part sought. Example: Determining the amount of fixed matter in organic substances by burning them and examining the ashes.

Sublimation is the process of distilling solid volatile substances from nonvolatile substances. Example: Camphor is separated from strips of wood from the camphor trees in this way.

What various forms of apparatus are used to modify and control heat? The water bath, salt-water bath, sand bath, oil bath, glycerin bath, etc.

What is the limit of temperature range of the several forms of bath? The water bath can only be used for temperatures below the boiling point of water, 100 C. (212 F.); a saturated solution of salt in water boils at 108.4 C. (227.1 F.). The salt-water bath may be used up to this temperature. Glycerin may be heated to 250 C. (480 F.). The oil bath is used to furnish a regulated temperature below 260 C. (500 F.), and the sand bath may be used at any temperature required by a pharmaceutical process.

What is distillation? The separation of one liquid from another, or a liquid from a solid, by vaporization and condensation. The volatile part is usually the object sought.

What is a still? Different forms of apparatus embodying the principles of the alembic and retort, either singly or com-

bined, used for distillation. When the neck of the retort is prolonged into a coil and immersed in water to condense the vapors it is called a worm.

What is sublimation? The process of distilling volatile solids; the product is called a sublimate. When a volatile product condenses at a temperature but slightly lower than the condensing point, deposition is slow and a large mass of crystals results. When the vapor is condensed rapidly at a low temperature a powder results.

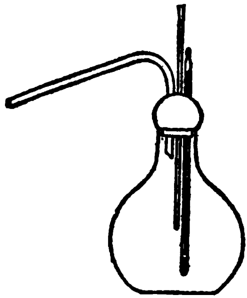

FIG. 90.—Distilling flask. (Remington.)

What is dessication? The operation of drying medicinal substances.

Give three objects for drying medicinal substances. (1) Preservation; (2) reduction of bulk; (3) to render comminution less difficult. The process is accomplished by different kinds of ovens and drying closets.

What is comminution? The process of tearing drugs to pieces or reducing them to very fine particles.

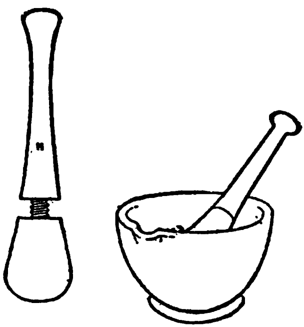

FIG. 91.—Pestle, hard rubber handle. Wedgwood mortar and pestle. (Remington.)

What are some of the processes for comminuting drugs? Cutting, rasping, grating, chopping, contusing, rolling, stamping, grinding, powdering, triturating, levigating, elutriating, granulating, etc.

What instruments are used for cutting, slicing, or chopping? Pruning knife, pruning shears, tobacco knife, or herb cutter.

What instrument is used for grating? A half-round rasp, kitchen grater, etc.

What instruments are used for contusion? Iron pestle, kitchen grater, etc., and mortar; or the pestle and mortar may be made of wood or earthenware.

What is grinding and pulverizing? Grinding comprehends the reduction of substances to coarse particles; pulverizing to fine particles.

What is a drug mill? A mill for comminuting drugs.

What is trituration? Rubbing substances to fine particles by means of a mortar and pestle.

What is the process? The pestle is given a circular motion with downward pressure. Beginning in the center of the mortar, work outward in increasing circles till the side of the mortar is touched, then reverse the process and decrease the size of the circles till the center is reached.

How should the pestle fit its mortar? The pestle should have as much bearing on the interior surface of the mortar as its size will permit to secure the maximum triturating surface.

Of what substances are pestles and mortars made? Wedgewood, porcelain, glass, and iron.

What is a spatula? A flexible steel blade fixed in a handle (or made entirely of steel, hard rubber, or horn), used for various purposes in pharmacy. In trituration it may be used to remove the substance from the sides of the mortar when it becomes packed thereon. An excellent type of spatula is one known as the balance handle.

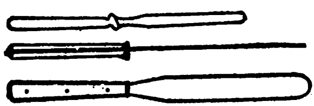

FIG. 92.—Spatulas. (Remington.)

How is the fineness of powders regulated? By sieves of various construction, with meshes of different sizes, as required. It is important that all portions of the sifted powder be thoroughly mixed in order to secure uniform composition. Powders are known as very fine (sieve with 80 meshes to the linear inch), fine (60 m. to l. i.), moderately fine (50 m. to l. i.), moderately coarse (40 m. to l. i.), coarse (20 m. to l. i.). These powders are also known by numbers 80, 60, 50, 40, and 20, respectively. Iron wire, brass wire, bolting cloth, and horse hair are the materials usually chosen for sieves.

What is levigation? The process of reducing substances to a state of minute division by triturating them after they have been made into paste with water or other liquid. A slab and

muller are used for this process. When made of porphyry it is termed porphyrization.

What is elutriation? If an insoluble powder be suspended in water, the heavier particles will precipitate first. By decantation of the liquid the finer portions may be separated. Prepared chalk is obtained by this process. The process of making the pasty mass obtained by elutriation into small cones is called trochiscation. A tinned iron cone with a handle is used for this purpose. The handle has a short leg in the center, which is tapped gently on a slab upon which the substance forced through the aperture at the bottom of the cone by shock falls in the form of a little conical mass. Successive shocks are employed, and the resulting conical masses deposited in this manner on the slab soon dry, the moisture being absorbed by the slab.

What is pulverizing by intervention? The process of reducing substances to powder through the use of a foreign substance from which the powder is subsequently freed by some simple method. Example: Camphor may be powdered with the aid of a few drops of alcohol. The foreign substance is freed from the powder by subsequent evaporation.

What is a solution? The permanent and complete incorporation of a solid or gaseous substance with a liquid. The product is called a solution, the liquid used a solvent; and if the solvent will dissolve no more of the substance the product is called a saturated solution.

What is the difference between a simple and a chemical solution? In simple solution no change occurs in the chemical structure of the dissolved substance (sugar in water); but in chemical solution chemical decomposition of one or more substances occur.

How are saturated solutions used as solvents? A liquid saturated with one substance is still a solvent for another substance.

What is the effect of solution upon temperature? Simple solution lowers temperature; chemical solution raises temperature.

What is the best manner of effecting the solution of a solid? Crush the substance in a mortar with the pestle, then pour on the solvent, continually stirring the mixture.

What solvents are used in pharmacy? Water, first in importance, then alcohol, glycerin, ether, benzin, chloroform, bisulphid of carbon, acids, and oils, take their respective rank as solvents.

SEPARATION OF FLUIDS FROM SOLIDS.

What are some of the processes for separating fluids from solids? Lotion, decantation, colation, filtration, clarification, expression, percolation, etc.

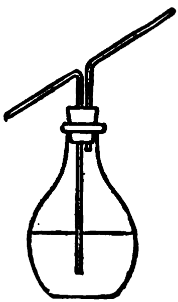

Fig. 93. — Spritz bottle. (Remington.)

What is lotion or displacement washing? The process of separating soluble matter from a solid by pouring a liquid upon it which will dissolve and wash out the soluble portion. Example: The washing of a precipitate in a funnel by means of a Spritz bottle. Various automatic apparatus for continuous washing are described in works on pharmacy.

What is decantation? Separating a liquid from a solid by pouring it off. This is sometimes better effected by a siphon.

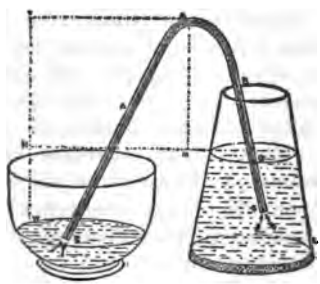

Fig. 94. — Siphonage. (Remington.)

What is a siphon? A siphon is an inverted U-tube with one leg longer than the other. It is first filled with the liquid, the shorter arm immersed in the liquid contained in the vessel, and a current established in this way: The weight of the column of liquid in the shorter arm is overbalanced by the longer arm, the shorter arm drawing a fresh supply from the vessel, which is thus finally emptied.

What is colation? Straining; the process of separating a solid from a fluid by pouring the mixture upon a cloth or porous substance which will permit the fluid to pass through, but will retain the solid.

What materials are used for strainers? Gauze, muslin, flannel, felt, etc.

What is filtration? The process of separating liquids from solids, with the view of obtaining the liquids in a transparent condition. Filters are made of paper, paper pulp, sand, asbestos, ground glass, charcoal, porous stone, etc.

What two general classes of paper filters are used? Plain and plaited. Plain filters are used for retaining and washing precipitates; plaited filters for ordinary operations.

FIG. 95.—Folded filter. (Remington.)

How are filter papers supported? In funnels.

What methods for producing rapid filtration are used? Various methods are used, such as suction with the mouth or by a volume of falling water, producing a partial vacuum beneath the filter and thus hastening the process by increasing atmospheric pressure.

What is clarification? The process of separating from liquids, without the use of strainers or filters, solid substances which interfere with their transparency.

Give eight principal methods of clarification. (1) By the application of heat. Heat, by diminishing the specific gravity of viscid liquids, permits the precipitation of the heavier particles, the lighter ones rising to the top. Boiling facilitates the separation, as the minute bubbles of steam adhere to the particles and rise with them to form scum, which may be skimmed off. (2) By increasing the fluidity of the liquid. This may be done by diluting it with water. Owing to the diminished specific gravity, the heavier particles sink and the liquid may then be decanted. (3) Through the use of albumen. If albumen be added to the turbid liquid and heat applied, on coagulating it

will envelop the particles and rise to the top with them. Skimming will remove the scum. (4) Through the use of gelatin. Gelatin will form with tannin an insoluble compound, and, where cloudiness is due to the presence of tannin, will clarify the liquid in this way. (5) Through the use of milk. Acids will precipitate the casein of milk. It is used in sour wines, etc., the precipitated casein carrying with it the insoluble particles. (6) Through the use of paper pulp. Agitate the liquid with the pulp and let it stand till clear, or throw the whole on a muslin strainer; the pulp will form an excellent filtering medium by partially closing the meshes of the linen. (7) By fermentation. Many substances soluble in the natural juices of plants are insoluble in the dilute alcoholic solutions resulting when these juices are fermented and subside as deposits. (8) By subsidence through long standing. The deposit formed is called a sediment.

What is the difference between a sediment and a precipitate? Sediment is solid matter separated merely by the action of gravity from a liquid in which it has been suspended. A precipitate, on the other hand, is solid matter separated from a solution by heat, light, or chemical action.

What is decoloration? The process of depriving liquids or solids in solution of color by the use of animal charcoal.

How are immiscible liquids separated? By the use of a pipette, a glass syringe, a separating funnel, or a Florentine receiver. A funnel with a stopcock to stop the flow as soon as the heavier liquid has all passed through is called a separating funnel. A Florentine receiver, used in the distillation of volatile oils, differs from an ordinary receiver in having an overflow arranged to permit the escape of the condensed water while retaining the volatile oil.

What is precipitation? The process of separating solid particles from a solution by the action of heat, light, or chemical reaction. The solid particles separated are called the precipitate, the precipitate producer a precipitant, and the liquid remaining supernatant liquid. A precipitate may either fall or

rise to the top of the supernatant liquid. The physical characteristics of precipitates are described by the words curdy, granular, flocculent, gelatinous, crystalline, bulky, etc. A magma is a thick tenacious precipitate. Precipitation by heat is illustrated by the coagulation and precipitation of albumin when albuminous fluids are heated, and the precipitation of silver salts by light illustrates precipitation by light. Precipitation by chemical reaction occurs in a large number of instances when making official chemical salts. Example: The preparation of precip. carb. calcium.

What is exsiccation? Depriving a solid crystalline substance of its water of crystallization or moisture by heating it strongly.

What is dialysis? The separation of crystallizable from noncrystallizable substances by osmosis.

What is a dialyzer? A vessel with a parchment head, like a drumhead, at one end, into which the substances to be separated are placed in the form of solution. This is floated on distilled water, and by osmosis the crystallizable substance transudes through the membrane into the water below, leaving the noncrystallizable substance behind.

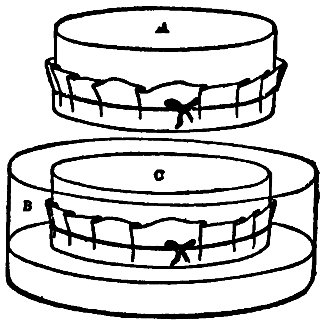

FIG. 96.—Dialyzer. (Remington.)

What are crystalloids? Crystallizable substances: Sugar, salt, certain chemical substances.

What are colloids? Noncrystallizable substances: Glue, gum, starch, dextrin, etc.

What is the diffusate? The distilled water impregnated with crystalloids.

What is extraction? The separation of the soluble principles from drugs by treating them with a liquid in which the principles are soluble. The solvent is called a menstruum.

Give five modes of extraction. (1) Maceration and expression, (2) percolation, (3) digestion, (4) infusion, (5) decoction.

What is maceration? Soaking a drug in a solvent until the soluble portion is dissolved.

What is expression? The process of forcibly separating liquids from solids by pressure.

Name six mechanical principles employed in constructing presses. (1) Spiral twist press, (2) screw press, (3) roller press, (4) wedge press, (5) lever press, (6) hydraulic press.

What is digestion? Maceration with gentle heat.

What is percolation? Percolation, also called displacement, is the process whereby a powder contained in a suitable vessel is deprived of its soluble constituents by the descent of a solvent through it. As directed in the United States Pharmacopeia, it consists in subjecting a substance, in powder, contained in a vessel called a percolator, to the solvent action of successive proportions of menstruum in such manner that the liquid, as it traverses the powder in its descent to the receiver, shall be charged with the soluble portion of it and pass from the percolator free from insoluble matter.

What is a percolator? A percolator is a cylindrical or conical vessel with a porous diaphragm below, into which the drug, in the form of a powder, is introduced and its soluble portions extracted by the descent of a solvent through it.

What is the process? The solvent, which is poured on the top of the powder, in passing downward exercises its solvent power on the successive layers of the powder until saturated, and is impelled downward by the combined force of its own gravity and that of the column of liquid above, minus the capillary force with which the powder tends to retain it.

What is a menstruum? The solvent used in percolation is known technically by this name.

What is a percolate? The liquid coming from the percolator impregnated with the soluble principles of the drug.

Why is percolation called the process of displacement? Because it was first observed that ether, poured on powdered bit-

ter almonds, displaced the fixed oil which it contains without materially mixing with it.

Why is maceration used? Percolation is not suitable for exhausting some drugs, and the process of maceration is employed for some of the tinctures (aloes, asafetida, sweet orange peel, tolu, etc.). Maceration should be conducted preferably at a temperature of about 15 to 20 C. (59 to 68 F.) and in a cool, dark place.

What is the best percolator for common use in small operations? An ordinary glass funnel.

What objection to the glass funnel is offered? It is too broad for use in percolating drugs for fluid extracts when the quantity of drug is large in proportion to the quantity of menstruum.

What is a desirable shape for making this class of preparations? A tall, narrow percolator, nearly cylindrical.

Why does the Pharmacopeia direct that the drug shall be passed through a coarse sieve after moistening? To render it uniform.

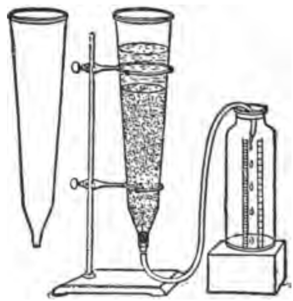

FIG. 97.—Official percolator on left and process of percolation. (Remington.)

Why should the powder be moistened? (1) A moist powder, like a moist sponge, greedily absorbs moisture, but a dry powder, like a dry sponge, repels attempts to moisten it; (2) dry powders have a tendency to swell when moistened, which, owing to the pressure of the particles against each other and the sides of the percolator, prevents moisture from penetrating them.

What are aquæ or waters? Aqueous solutions of volatile substances. There are 18 official waters.

What are the official directions? The medicated waters, when prepared from volatile oils, are intended to be, as nearly as practicable, saturated solutions, which must be clear and free from solid impurities.

Give methods of preparation. (1) Simple solution in cold water, agitation; aqua amygdalæ amaræ, chloroformi, creosoti; passing gases through water, aqua ammoniæ, ammoniæ fortior.

(2) Solution in hot water: Shake the oil with hot water; let stand until cold; decant and filter. Volatile oils are made more soluble in hot than in cold water.

(3) Filtration through an absorbent powder. Aqua anisi, camphoræ, cinnamomi, feniculi, menthæ piperitæ, and menthæ viridis are made by filtration through impregnated purified talc. In preparing aqua camphoræ a little alcohol is used to dissolve the camphor before mixing with the talc.

(4) Filtration through pulp or shredded filter paper. Drop volatile oil upon white filtering paper, tear paper into shreds, transfer to flask or stoneware jar, add boiling water in portions, shake thoroughly, cool, filter, and adjust quantity by pouring distilled water through the filter.

(5) Distillation. Aqua aurantii florum fortior, hamamelidis, rosæ fortior, and aqua destillata.

What is a liquor, or pharmaceutical solution? An aqueous solution of a nonvolatile substance. Liquors are divided into two classes, according to the method of preparation, viz, simple solutions and chemical solutions. There are 25 official liquors. There is one exception to the rule that these preparations are nonvolatile. Liquor ammonii acetatis may be completely volatilized by boiling.

What is a sirup? A dense saccharine solution, generally medicated or flavored.

What is sugar? Sugar is in white, dry, hard, distinctly crystalline granules, permanent in the air, odorless, having a purely sweet taste and a neutral reaction; commercially known as "granulated sugar." Simple sirup: When water alone is used in making the solution of sugar. Medicated sirups: When the water contains soluble principles from various medicinal substances. There are 22 official sirups.

What are mellita or honeys? Thick liquid preparations closely allied to sirups, differing merely in the use of honey as

base instead of sirup. There are but three official honeys, only one of which contains a medicinal substance—honey of rose.

What are mucilages? Thick, viscid, adhesive liquids produced by dissolving gum in water, or by extracting with water the mucilaginous principles from vegetable substances both with and without heat. Two mucilages are official.

What is an emulsion? A soft, liquid preparation resembling milk, and consisting of an oily or resinous substance suspended in water by means of gum, yolk of egg, or other viscid matter. Emulsions may be divided into three classes—natural emulsions, gum-resin and seed emulsions, and oil or artificial emulsions. Natural emulsions: Those that exist ready formed in nature. Examples: Milk, egg yolk, various plant juices, etc. Four emulsions are official.

What is a mixture? An aqueous liquid preparation intended for internal use which contains suspended insoluble substances. Two mixtures are official.

What are glycerites? Mixtures or solutions of medicinal substances in glycerin. Five glycerites are official.

What are spirits? Alcoholic solutions of volatile substances. They may be classified according to the method of preparation as follows: (1) Simple solution; (2) solution with maceration; (3) gaseous solution; (4) chemical reaction; (5) distillation.

How many spirits are recognized as official? Fifteen. (Those made from volatile oils are frequently called essences.)

What is an elixir? Elixirs are aromatic, sweetened, spiritous preparations, containing small quantities of active medicinal substances. There are two official elixirs.

What are collodions? Collodions are liquid preparations intended for external use, having for the base a solution of pyroxylin, or guncotton, in a mixture of ether and alcohol. They leave a film on evaporation, which serves as a protection or an application of a medicinal ingredient to the skin. Three collodions are official.

What are liniments? Solutions of various substances or mixtures in oily or alcoholic liquids containing fatty oils, intended

for application to the skin by rubbing. There are eight official liniments. Three with fixed oil base—ammoniæ, calcis, and camphoræ; four with alcohol as the principal fluid—belladonnæ, chloroformi, saponis, and saponis mollis; one contains oil of turpentine, viz, terebinthinæ.

What are oleates? The oleates are liquid preparations, made by dissolving metallic salts, or alkaloids, in oleic acid. They are not assumed to be definite chemical compounds. One oleate is official.

What are infusions? Infusions are liquid preparations, made by treating vegetable substances with either hot or cold water. They are not boiled, though boiling water is often employed. Two infusions are official.

What is a tincture? A tincture is an alcoholic solution of a nonvolatile substance. There is one exception to this rule, viz, tincture of iodin; the reason for this preparation being retained in this class is that it was believed inadvisable to change the name by which it has been known to the general public through many years.

What processes are used in the preparation of tinctures? Percolation, maceration, solution, or dilution.

What is the menstruum employed? Alcohol, diluted alcohol of various strengths; aromatic spirit of ammonia; or mixtures of alcohol and water and glycerin.

What is an example of a tincture made by solution or dilution? Tr. iodin, made by dissolving iodin in alcohol.

Give two general classes of tinctures. Simple and compound tinctures.

Why is glycerin used in tinctures? To prevent precipitation on standing, and to assist in solution of ingredients.

How many official tinctures are in the United States Pharmacopeia? Fifty-four.

Classify them in groups; give the menstruum of each. In compound tinctures give the percentage of each drug of which they are composed.

Tinctures.	Formulas.	Menstruums.	Dosage.
1.6 per cent.		*Mils.*	
Opii camphorata....	Pwd. opium, benz. acid, camp., each 4 gm.; ol. anise, 4 mils.	G., 40; D. A. to 1000.	4 mils (1 fl. dr.).
4.5 per cent.			
Lavandulæ composita..............	Ol. lav. fl., 8 mils; ol. rosem, 2 mils; s. cin., 20 gm.; cloves, 5 gm.; nutmeg, 10 gm.; r. saund, 10 gm.	A., 750; W., 250.	2 mils (30 m.).
5 per cent.			
Gambir composita..	Gambir, 50 gm.; s. cin., 25 gm.	D. alcohol.......	4 mils (1 fl. dr.).
Moschi.............	Musk, 5 gm............	A., 50; W., 50...	4 mils (1 fl. dr.).
6.2 per cent.			
Cardamomi composita............	Card., 20 gm.; s. cin., 25 gm.; caraway, 12 gm.; coch., 5 gm.	G., 50; D. alcohol, 950.	4 mils (1 fl. dr.).
7 per cent.			
Iodi................	Iodin, 70 gm.; KI, 50 gm.	A., 950; W., 50..	0.1 mil (1½ m.).
10 per cent.			
Aconiti.............	Aconite, 100 gm.........	A., 700; W., 300.	0.3 mil (5 m.).
Aloes...............	Aloes, 100 gm.; glycyrr., 200 gm.	D. alcohol.......	2 mils (30 m.).
Belladonnæ foliorum.	Belladonna lvs., 100 gm.	D. alcohol.......	0.75 mil (12 m.).
Cannabis............	Cannabis, 100 gm........	Alcohol..........	0.75 mil (12 m.).
Cantharidis.........	Cantharides, 100 gm.....	Alcohol..........	0.1 mil (1½ m.).
Capsici.............	Capsicum, 100 gm.......	A., 950; W., 50..	0.5 mil (8 m.).
Colchici seminis.....	Colch. seed, 100 gm......	A., 600; W., 400.	2 mils (30 m.).
Digitalis............	Digitalis, 100 gm........	A., 750; W., 250.	0.5 mil (8 m.).
Gelsemii............	Gelsemium, 100 gm......	A., 650; W., 350.	0.25 mil (4 m.).
Gentianæ composita	Gent., 100 gm.; b. or. peel, 40 gm.; card., 10 gm.	G., 100; A., 500; W., 400.	4 mils (1 fl. dr.).
Hyoscyami.........	Hyoscyam., 100 gm......	D. alcohol.......	2 mils (30 m.).
Kino................	Kino, 100 gm............	A. 500; W., 500..	4 mils (1 fl. dr.).
Lobeliæ.............	Lobelia, 100 gm..........	D. alcohol.......	1 mil (15 m.).
Nucis vomicæ.......	Nux. vom., 100 gm	A., 750; W., 250.	0.5 mil (8 m.).
Opii................	Gr. opium, 100 gm......	A., 500; W., 500.	0.5 mil (8 m.).
Opii deodorati......	Gr. opium, 100 gm......	A., 200; p. benz., 75; W., to 1000.	0.5 mil (8 m.).
Physostigmatis.....	Physostigma, 100 gm....	Alcohol..........	1 mil (15 m.).
Sanguinariæ........	Sanguinaria, 100 gm.....	Hcl., 10; A., 600; W., 400.	1 mil (15 m.).
Scillæ..............	Squill, 100 gm..........	A., 750; W., 250.	1 mil (15 m.).
Stramonii..........	Stramonium, 100 gm....	D. alcohol.......	0.5 mil (8 m.).
Strophanthi........	Strophanthus, 100 gm...	P. benz.; A......	0.5 mil (8 m.).
Veratri viridis......	Veratrum vir., 100 gm...	Alcohol..........	0.5 mil (8 m.).

Tinctures.	Formulas.	Menstruums.	Dosage.
13.3 per cent.		*Mils.*	
Ferri chloridi	Sol. ferric chlor., 350 mils.	Alcohol	0.5 mil (8 m.).
15 per cent.			
Cardamomi	Cardamom, 150 gm	D. alcohol	2 mils (30 m.).
20 per cent.			
Arnicæ	Arnica, 200 gm	D. alcohol	1 mil (15 m.).
Asafetidæ	Asafetida, 200 gm	Alcohol	1 mil (15 m.).
Aurantii amari	Bitter orange peel, 200 gm.	A., 600; W., 400.	4 mils (1 fl. dr.).
Benzoini	Benzoin, 200 gm	Alcohol	1 mil (15 m.).
Calumbæ	Calumba, 200 gm	A., 600; W., 400.	4 mils (1 fl. dr.).
Cinchonæ	Cinchona, 200 gm	A., 675; W., 250; G., 75.	4 mils (1 fl. dr.).
Cinchonæ composita	R. cinchon., 100 gm.; bitter orange peel, 80 gm.; serpent., 20 gm.	G., 75; A., 675; W., 250.	4 mils (1 fl. dr.).
Cinnamomi	Saigon cin., 200 gm	G., 75; A., 675; W., 250.	2 mils (30 m.).
Guaiaci	Guaiac, 200 gm	Alcohol	4 mils (1 fl. dr.).
Guaiaci ammoniata	Guaiac, 200 gm	Spt. ammon. arom.	2 mils (30 m.).
Hydrastis	Hydrastis, 200 gm	A., 650; W., 350.	4 mils (1 fl. dr.).
Myrrhæ	Myrrh, 200 gm	Alcohol	1 mil (15 m.).
Pyrethri	Pyrethrum, 200 gm	Alcohol	
Quassiæ	Quassia, 200 gm	A., 350; W., 650	2 mils (30 m.).
Rhei	Rhubarb, 200 gm.; card., 30 gm.	G., 100; A., 500; W., 400.	4 mils (1 fl. dr.).
Rhei aromatica	Rhub., 200 gm.; s. cin., 40 gm.; clove, 40 gm.; nutmeg, 20 gm.	G., 100; A., 500; W., 400.	2 mils (30 m.).
Tolutana	Balsam of tolu, 200 gm	Alcohol	2 mils (30 m.).
Valerianæ	Valerian, 200 gm	A., 750; W., 250.	4 mils (1 fl. dr.).
Valerianæ ammoniata.	Valerian, 200 gm	Spt. ammon. arom.	2 mils (30 m.).
Zingiberis	Ginger, 200 gm	Alcohol	2 mils (30 m.).
24 per cent.			
Benzoini composita.	Benz., 100 gm.; p. aloes, 20 gm.; storax, 80 gm.; b. tolu, 40 gm.	Alcohol	2 mils (30 m.).
50 per cent.			
Aurantii dulcis	Sweet orange peel from fresh fruit, 500 gm.	Alcohol	4 mils (1 fl. dr.).
Lactucarii	Lactucarium, 500 gm	G., 250; p. benz., D. A.	2 mils (30 m.).
Limonis corticis	Lemon peel from fresh fruit, 500 gm.	Alcohol	

A.=Alcohol. W.=Water. D. A.=Dilute alcohol. G.=Glycerin. HCl.=Hydrochloric acid. P. benz.=Purified petroleum benzin.

Give the standardized tinctures required by the United States Pharmacopeia to have a definite alkaloidal strength and the alkaloidal percentage of each.

	Should contain in 100 mils—
Aconiti	0.045 to 0.055 gm.
Belladonnæ foliorum	.027 to .033 gm.
Cinchonae	.8 to 1.0 gm.
Cinchonæ composita	.4 to .5 gm.
Colchici seminis	.036 to .044 gm.
Hydrastis	.036 to .044 gm.
Hyoscyami	.0055 to .0075 gm.
Nucis vomicæ	.237 to .263 gm.
Opii	.95 to 1.05 gm.
Opii deodorati	.95 to 1.05 gm.
Physostigmatis	.013 to .017 gm.
Stramonii	.0225 to .0275 gm.

What are vina medicata, or medicated wines? Medicated wines are liquid preparations containing the soluble principles of medicinal substances dissolved in wine. The United States Pharmacopeia does not include any of these.

What amount of alcohol should wine contain? Not less than 7 nor more than 12 per cent, by weight (equivalent to 8.5 to 15 per cent by volume), of absolute alcohol.

What are fluidextracts? Liquid alcoholic preparations of nearly uniform and definite strength, made by percolating drugs with menstruums and concentrating a portion of the percolate so that in each case a mil of fluidextract represents the medicinal virtue of 1 gram of the drug. They are mostly concentrated tinctures.

Give a typical formula for an official fluidextract. One thousand grams of the powdered drug are moistened with a certain quantity of menstruum, packed in a suitable percolator, and enough menstruum added to saturate the powder and leave a stratum above it. The lower orifice of the percolator is closed when the liquid begins to drop; the percolator is closely covered to prevent evaporation and permit maceration for a speci-

fied time; additional menstruum is poured on and percolation continued slowly until the drug is exhausted. Usually about 800 mils of the first portion of the percolate is reserved and the remainder evaporated at a temperature not exceeding 50 C. (122 F.) to a soft extract. This is to be dissolved in the reserved portion and enough menstruum added to make the fluidextract measure 1,000 mils.

Give the standardized fluidextracts and their alkaloidal percentages.

	Should contain in 100 mils—
Aconiti	0.45 to 0.55 gm.
Belladonnæ radicis	.405 to .495 gm.
Cinchonæ	4 to 5 gm.
Colchici seminis	.36 to .44 gm.
Guaranæ	3.6 to 4.4 gm.
Hydrastis	1.8 to 2.2 gm.
Hyoscyami	.055 to .075 gm.
Ipecacuanhæ	1.8 to 2.2 gm.
Nucis vomicæ	2.37 to 2.63 gm.
Pilocarpi	.55 to .65 gm.

What are oleoresins? Official liquid preparations, consisting principally of natural oils and resins extracted from vegetable substances by percolation with acetone. They are the strongest liquid preparations of drugs produced. Six oleoresins are official.

What is the general formula for their preparation? Percolate the powdered drug in a cylindrical percolator provided with a stopcock, cover, and receptacle suitable for volatile liquids, with acetone until exhausted, recovering the greater part of the acetone by distillation, and exposing the residue in a capsule to spontaneous evaporation until the remaining acetone has evaporated.

What are aceta or vinegars? Medicated vinegars are solutions of the active principles of drugs in diluted acetic acid, the latter being chosen as a menstruum, because acetic acid is not only a good solvent, but also possess antiseptic properties. Their use dates from the time of Hippocrates. Acetic acid is

also of value as a menstruum, as it produces soluble salts with the alkaloidal principles existing in plants. One vinegar is official.

What are extracts? Extracts are solid or semisolid preparations produced by evaporating solutions of vegetable substances.

Give the standardized extracts of the United States Pharmacopeia and their alkaloidal percentages.

	Should contain in 100 gms—
Aconiti	1.8 to 2.2 gm.
Belladonnæ foliorum	1.18 to 1.32 gm.
Colchici cormi	1.25 to 1.55 gm.
Hydrastis	9.0 to 11.0 gm.
Hyoscyami	.22 to .28 gm.
Nucis vomicæ	15.2 to 16.8 gm.
Opii	19.5 to 20.5 gm.
Physostigmatis	1.7 to 2.3 gm.
Stramonii	.9 to 1.1 gm.

What are resinæ or resins? The official resins are solid preparations, consisting principally of the resinous principles from vegetable bodies, prepared by precipitating them from their alcoholic solution with water. Four resins are official, including commercial resin (rosin), the residue obtained after distilling the volatile oil from turpentine.

What are triturations? A class of powders first introduced into the United States Pharmacopeia of 1880 for the purpose of fixing a definite relation between the active ingredient and the diluent. They contain:

Of the substance, 10 gm.

Sugar of milk, in moderately fine powder, 90 gm.

One trituration is official—trituration of elaterin.

What are confections? Saccharine, soft solids, in which one or more medicinal substances are incorporated with the object of affording an agreeable form for their administration and a convenient method for their preservation. Old names are conserves and electuaries, under which they have been in use for centuries. No confections are official.

What are pilulæ or pills? Small, solid bodies of a globular, ovoid, or lenticular shape, which are intended to be swallowed, and thereby produce medicinal action. There are seven official pills.

Of what is a pill mass composed, and what is required of it? It is composed of ingredients and excipients. It is required that the mass be: (1) Adhesive, (2) firm, (3) plastic.

How are pills finished to keep them from adhering together? Finish them either by rolling between the thumb and finger or rotating them under an adjustable pill finisher. To prevent them from adhering together dust with rice flour, powdered magnesium carbonate, lycopodium, powdered althæa, or powdered licorice root.

What are trochisci or troches? Troches, or lozenges, are solid discoid or cylindrical masses, consisting chiefly of medicinal powders, sugar, and mucilage. They are prepared by making the ingredients into a mass, which is rolled into a thin sheet and cut into proper shape with a lozenge cutter. There are five official troches.

What are cataplasms? They are soft, ointmentlike, medicated substances, of such consistency that they may be easily spread upon muslin or similar material and produce local or systemic effects. No cataplasms are official.

What are cerata or cerates? Cerates are unctuous substances of such consistency that they may be easily spread at ordinary temperatures upon muslin or similar material, with a spatula, and yet not so soft as to liquefy and run when applied to the skin. Four cerates are official.

Why are they called cerates? Owing to the presence of wax (cera) as a principal ingredient.

What substances are used for bases? Oil, lard, and petrolatum. Wax and sometimes paraffin or spermaceti in the presence of wax are used to raise the melting point of the bases.

What are unguenta or ointments? Fatty preparations of a softer consistency than cerates, intended to be applied to the skin by inunction. Twenty ointments are official.

What are emplastra or plasters? Substances intended for external application, of such consistency that they adhere to the

skin and require the aid of heat in spreading them. Seven plasters are official.

How are they usually spread? On muslin, leather, paper, etc., and have a basis, lead plaster, a gum-resin, or Burgundy pitch. As plasters are usually bought of the manufacturer ready made, a description of the process for spreading them is omitted.

What are chartæ or papers? A small class of preparations intended for external application. Made by applying the medicinal substance to the surface of the paper by the addition of some adhesive liquid. No papers are official.

What are suppositories? Solid bodies of various weights and shapes, adapted for introduction into the rectum, urethra, or vagina, and composed of such substances as will retain their shape at ordinary temperatures and melt readily at blood heat. The suppository of glycerin is the only one official.

What vehicles are used in suppositories? The vehicles usually employed are oil of theobroma, glycerinated gelatin, or sodium stearate. They should be prepared of materials of sufficient consistency to retain their shape when inserted and at the same time melt at the temperature of the body.

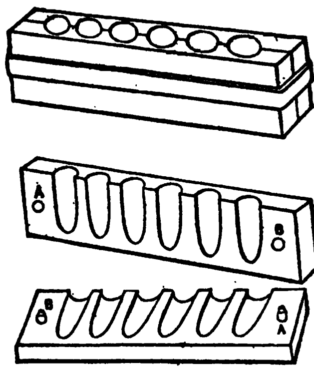

Fig. 98.—Suppository molds. (Remington.)

From what kingdoms are the materials of the United States Pharmacopeia obtained? From the animal, vegetable, and mineral kingdoms.

Are all parts of substances used as medicines active? They are not. All materials of the vegetable and animal kingdoms from which medicines are obtained contain both active and inert substances. In a number of plants the active principles are termed either alkaloids or glucosides. In the animal kingdom the therapeutic principle is frequently an enzyme or fer-

ment (as pepsin), or is referred to simply as an active principle. A crude vegetable drug may contain a number of alkaloids, as do cinchona and opium, and an animal substance may contain a number of ferments, as pancreatin.

What is an alkaloid? An alkaline substance occurring in the tissues of an animal or plant. It contains nitrogen, has a definite chemical composition, and is capable of combining with acids to form salts. Their names terminate in "in" in English and "ina" in Latin.

What are glucosides? Glucosides or neutral principles occur in many vegetable substances; when treated with dilute acids they yield glucose as a product of decomposition. Their names terminate in "in" in English and "inum" in Latin. Santonin and digitalin are glucosides.

Into what classes are acids divided? Mineral acids and organic acids; the former are obtained from the mineral kingdom, as sulphuric and nitric acids; the latter from the vegetable and animal kingdoms, as citric and oleic acids.

PRESCRIPTIONS.

What is a prescription? A formula which a physician writes, specifying the substances he intends to have administered to a patient.

In what language is it written, and for what reason? Latin; it is the language of science and is understood throughout the civilized world; it is a dead language and not subject to change.

What are the parts of a prescription? (1) The superscription or heading; (2) the name of the patient; (3) the inscription, or the names and quantities of the ingredients; (4) the subscription, or the directions to the compounder; (5) the signa (mark) or the directions for the patient; (6) the name or initials of the physician, with the date.

What is the superscription? It consists of the Latin symbol ℞, which is an abbreviation of the word "recipe" ("take"), the imperative of the Latin word "recipio."

Why should the name be on every prescription? To avoid being given to the wrong person.

Of what four parts may the inscription be composed? (1) The basis, the chief, active ingredient; (2) the adjuvant or aid to the basis to assist its action; (3) the corrective, which is intended to qualify the action of the basis and adjuvant; (4) the vehicle, the ingredient which gives the whole the proper consistency, form, and color.

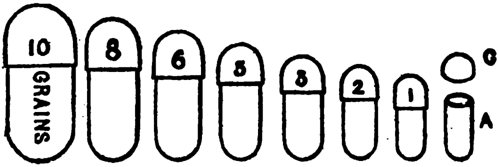

FIG. 99.—Empty capsules. (Remington.)

Give a model prescription.

Mr. Richard Roe. 10/6/15.

℞

Chloralis hydrati	8 gm. (ʒii)
Potassii bromidi	16 gm. (ʒiv)
Sirupi zingiberis	30 mils (f℥i)
Sirupi q. s. ad	90 mils (f℥iii)

Misce et signa: Two teaspoonfuls as needed.

JOHN DOE, M. D.

Here the chloral is the basis, the bromid the adjuvant, the sirup of ginger the corrective, and the simple sirup the vehicle.

What numerals are used to designate quantities, and where are they written when using apothecaries measure? Roman, as i, v, x, c, etc. Where more than one i is used, the j is often used, as ij. They are always written after the ingredient.

What is usually included in the subscription? The letter M, or *misce;* S, or *solve;* F, *fiat;* etc.

What should be included in the signa? The directions to the patient, written in English. The date should also be included.

What is to be said of the signature? The signature is necessary to indicate that the prescription has been written by one duly qualified, as required by law.

Enumerate the principal words used in prescription writing; give their contractions or abbreviations and the meaning of each.

66071°—17——14

Word or phrase.	Contraction.	Meaning.
Ad	Ad	To, up to.
Ad conciliandum gustum		To suit the taste.
Add, addantur, addendus, addendo.	Add	Add, or let them be added, to be added, by adding.
Ad libitum	Ad lib	At pleasure.
Ana	A., aa	Of each.
Ante cibum	A. c.	Before a meal.
Aqua bulliens	Aq. bull	Boiling water.
Aqua communis	Aq. comm	Common water.
Aqua fervens	Aq. ferv	Hot water.
Bene		Well.
Bis		Twice.
Bis in die	Bis in d	Twice a day.
Charta	Chart	Paper.
Cibus		Food.
Cochlear or cochleare cochleatim.	Coch., cochleat.	Spoonful, by spoonfuls.
Cochleare amplum	Coch. amp	A tablespoonful.
Cochleare magnum	Coch. mag	A large spoonful (about half ounce).
Cochleare medium or modicum	Coch. med	A dessertspoonful (about 2 fluidrams).
Cochleare parvum	Coch. parv	A teaspoonful (about 1 fluidram).
Cola	Col	Strain.
Collyrium	Collyr., Coll	An eyewash.
Congius	Cong	A gallon.
Contra		Against.
Cortex	Cort	The bark.
Cum	C	With.
Dividatur	D. in p. seq	Let it be divided into equal parts.
Eadem (fem)		The same.
Ejusdem	Ejusd	Of the same.
Et		And.
Fac., fiat	F., ft	Make, let it be made, let them be made.
Fiant chartulæ xii	Ft. chart. xii	Make 12 powders.
Fiant pilulæ xii	Ft. pil. xii	Make 12 pills.
Fiant pulveres xii	Ft. pulv. xii	Make 12 powders.
Fiat secundum artis regulas	F. s. a. r	Let it be made according to the rules of art.
Fiat solutio	Ft. solut	Make a solution.
Filtra		Filter (thou).
Gargarisma	Garg	A gargle.
Gutta	Gtt	A drop.
Guttæ	Gtt	Drops.
Guttatim	Guttat	By drops.
Idem		The same.
Partes æquales	P. æ	Equal parts.
Post cibum	P. c	After a meal.
Pro re nata	P. r. n	Occasionally.
Quantum sufficiat, quantum satis.	Q. s	As much as is sufficient.
Secundum artem, secundum naturam.	S. a., s. n	According to art.
Semis	Ss	A half.
Signa	Sig	Mark thou.
Solve		Dissolve.
Supra		Above.
Ter in die, or ter die	T. i. d., or t. d.	Three times a day.
Uncia		An ounce.

What is understood by incompatibility? It is a term used to express the effects produced in pharmaceutical mixtures by chemical decomposition, physical dissociation, incomplete solution, or therapeutic opposition. It may be divided into three classes—chemical incompatibility, physical incompatibility, and therapeutic incompatibility.

What is chemical incompatibility? The result of chemical action which results in the decomposition of one or more of the ingredients entering into the prescription. It may result in unintentional precipitate, explosives, or poisonous compounds.

Give examples of chemical incompatibility. A preparation containing tannic acid when combined with iron salts produces tannate of iron, resulting in an inky mixture; as a mixture of the tinctures of chlorid of iron and gentian compound; a solution of an alkaloidal salt with an alkali precipitates the alkaloid, as a solution of morphin sulphate to which bicarbonate of potash is added would precipitate the morphin; permanganate of potash and glycerin mixture would result in an explosive compound.

What is physical incompatibility? The condition arising from the mixture of pharmaceutical preparations which results in the physical dissociation of one or more constituents.

Give examples of physical incompatibility. A solution of sulphate of magnesia to which tincture of orange is added would result in a mass of crystals of the salt as a result of the insolubility in alcohol; tincture of chlorid of iron added to sirup of acacia would gelatinize; codliver oil added to sirup of orange would separate unless made into an emulsion.

What is therapeutic incompatibility? The condition arising from the combination of remedies which are mutually opposed to one another in therapeutic effect.

Give examples of therapeutic incompatibility. A solution of bromid of potash and strychnin; a pill of opium and caffein. In both examples the drugs are mutually antagonistic. A solution of pepsin to which an alkali has been added is inert, as pepsin is effective only in acid solutions.

CHAPTER 10.

MATERIA MEDICA.

What is materia medica? A treatise upon materials, agents, or appliances used in medicine; includes name, source, or origin, habitat, family or natural order, physical characteristics, methods by which obtained, tests for, constituents, forms of administration, methods of administration, physiological action and therapeutics, normal dosage, antagonists, incompatibilities, synergists.

What is therapeutics? A knowledge of all those sciences included in the art of healing.

What is rational therapeutics? That branch of therapeutics based on known laws of remedies and diseases gained through physiology, pathology, pharmacology, and pharmacodynamics.

What is empirical therapeutics? That based solely on clinical observation and experience.

What are hygienic agents? Cleanliness, pure air, ventilation, proper food (dietetics), etc.

What does mechanical therapeutics include? Bleeding, leeches, cups, massage, friction, lavage, sprays, trusses, suspensories, bandages, etc.

How is heat applied as a curative agent? By judicious exposure to the direct rays of the sun, application of artificial heat (hot-water bags, etc.), and vapors.

How is cold applied as a curative agent? By the use of the different baths, such as plunge, shower, wet pack, sponge, ice pack, etc.

How do light and darkness act in the treatment of disease? Light stimulates. darkness produces a sedative effect.

How is electricity used in the treatment of disease? By the use of various currents, galvanic, faradic, and static; electric baths, brushes, high frequency, and electric massage.

Where are the materials used in medicine obtained? From the three kingdoms—animal, vegetable, and mineral—and, according to their composition, are either inorganic or organic.

Into what two groups or divisions are all medicinal materials divided? Stimulants or sedatives, according to their effect.

What are stimulants? Agents or remedies which increase the functional activity of the body or any organ or tissue.

What are sedatives? Agents or remedies which lessen or reduce the functional activity, and so exert a soothing influence upon the system.

Enumerate the principal terms descriptive of the therapeutic action of medicines, and give the meaning of each.

ABSORBENTS: Drugs used to produce absorption of exudates or diseased tissues.

ALTERATIVES: Medicines used to modify nutrition so as to overcome morbid processes.

ANALGESICS OR ANODYNES: Medicines used to allay pain.

ANAPHRODISIACS: The reverse of aphrodisiacs.

ANESTHETICS: Medicines used to produce anesthesia or unconsciousness.

ANHIDROTICS: Medicines which diminish the secretion of the skin (the reverse of diaphoretics).

ANTACIDS: Medicines used to neutralize acid in the stomach and intestines.

ANTAGONISTS: Medicines or agents which directly oppose each other in some or all of their physiological actions, and may be used one against the other in a case of poisoning by either, to counteract the effect upon the organism *after it has been absorbed* and the time for an antidote has passed.

ANTHELMINTICS: Medicines to destroy intestinal worms.

ANTIDOTES: Medicines or agents which act upon poisons in such a manner as to alter their composition, rendering them less poisonous, and so *preventing* their toxic action from being exerted upon the organism.

ANTIEMETICS: Medicines or agents which lessen nausea and vomiting, either by local action or by reducing the irritability of the vomiting center in the medulla.

ANTIPERIODICS: Medicines used for the relief of periodically recurring diseases, such as malaria.

ANTIPHLOGISTICS OR DISCUTIENTS: Medicines or agents which reduce or dissipate inflammation.

ANTIPYRETICS: Medicines used in the reduction of bodily temperature in fevers.

ANTISEPTICS: Substances which have the power of preventing putrefaction.

ANTISIALICS: Medicines or agents which reduce the secretion of the saliva.

ANTISPASMODICS: Medicines used for the relief of nervous irritability and minor spasms.

ANTISYPHILITICS: Medicines used for the relief of syphilis.

APHRODISIACS: Medicines which stimulate the sexual appetite and function.

AROMATICS: Medicines characterized by a fragrant or spicy taste and odor and stimulant to the gastro-intestinal mucous membrane.

AROMATIC BITTERS: Medicines which unite the properties of the aromatics and simple bitters.

ASTRINGENTS: Medicines which produce contraction of muscular fibers and condensation of other tissues and lessen secretion from the mucous membranes.

BITTERS, SIMPLE: Medicines which have a bitter taste and have the effect of stimulating the gastro-intestinal mucous membrane without affecting the general system.

CARDIAC DEPRESSANTS: Medicines used to lower the action of the heart.

CARDIAC STIMULANTS: Medicines used to increase the action of the heart.

CARMINATIVES: Medicines which aid in the expulsion of gas from the stomach and intestines by increasing peristalsis, stimulating circulation, etc.

CATHARTICS OR PURGATIVES: Medicines which increase or hasten the evacuation of the intestines. They are classified according to their power, as follows: *Laxatives* or *aperients*, *simple purgatives*, *drastic purgatives*, *saline purgatives*, *hydrogogues*, *cholagogues*.

CEREBRAL DEPRESSANTS: Medicines which lower or suspend the functions of the higher brain after a preliminary stage of excitement.

CEREBRAL EXCITANTS: Medicines which increase the functional activity of the cerebrum without causing any subsequent depression or suspension of the brain function if given in proper doses.

CORRECTIVES: Medicines which are used to correct or render more pleasant the action of other remedies, especially purgatives.

DELIRIANTS: Medicines which excite the functional activity of the higher brain to such a degree as to disorder the mental faculties and produce intellectual confusion, loss of will power, delirium, and even convulsions.

DEMULCENTS: Mucilaginous principles of vegetable drugs in solution or oils, used to soothe and protect irritated mucous membranes or other tissues.

DEODORANTS: Substances which destroy or hide foul odors.

DIAPHORETICS: Medicines which produce increased excretion of sweat.

DIGESTANTS: Ferments and acids which have the power of aiding in the solution of food.

DILUENTS: Medicines which dilute secretions and excretions.

DISINFECTANTS: Substances which have the power of destroying disease germs or the noxious properties of decaying organic matter.

DIURETICS: Medicines which increase the secretion of the urine.

EMETICS: Medicines which cause vomiting.

ESCHAROTICS OR CAUSTICS: Substances which destroy the life of the tissue to which they are applied, leaving a scar following the slough that is first produced.

EXPECTORANTS: Medicines which act upon the bronchopulmonary mucous membrane and increase or alter its secretion.

FEBRIFUGES: Medicines which dissipate fever.

HEMOSTATICS: Medicines which arrest hemorrhages (usually applied to internal bleeding).

HEPATIC STIMULANTS: Medicines which increase the functional activity of the liver cells and the amount of bile secreted.

HYPNOTICS: Medicines which, in proper doses, produce sleep without narcotic or deliriant effects.

IRRITANTS: Substances which, when applied to the skin, produce more or less vascular excitement. When employed to excite a reflex influence on a part remote from the place of application they are termed *counterirritants*. *Rubefacients*, the mildest of this group, cause redness (congestion) of the skin. *Vesicants*, or blistering agents, produce decided inflammation of the skin and the accumulation of serum between the epidermis and the derma. *Pustulants* affect isolated parts of the skin, such as the mouths of glands, and give rise to pustules.

MOTOR DEPRESSANTS: Medicines which lower the functional activity of the spinal cord and motor apparatus, and in large doses paralyze them directly.

MOTOR EXCITANTS: Medicines which increase the functional activity of the spinal cord and motor apparatus, producing heightened reflex excitability, disturbances of motility, and tetanic convulsions when given in large doses, their ultimate result being motor paralysis from overstimulation.

MYDRIATICS: Medicines which cause dilatation of the pupil.

MYOTICS: Medicines which cause contraction of the pupil.

NARCOTICS: Drugs which "lessen the relationship of the individual to the external world." At first excitant to the higher brain, they soon cause profound sleep, characterized by increasing stupor, and, if the dose be sufficient, coma, insensibility, and death by paralysis of the nerve centers which control organic life.

NEUROTICS: Medicines which act upon the nervous system.

NUTRIANTS: Medicines which modify the nutritive processes.

NUTRIENTS: Substances which give nourishment to the system.

PARASITICIDES: Medicines which destroy the various animal and vegetable organisms which live upon the human body.

PROPHYLACTICS: Medicines which prevent the taking or development of disease.

PULMONARY SEDATIVES: Medicines which relieve cough and dyspnea by lessening the irritability of either the respiratory center or the nerves of respiration.

REFRIGERANTS: Medicines which impart a sensation of coldness and thereby allay thirst and restlessness.

RENAL DEPRESSANTS: Medicines or agents which lessen the secretion of the urine.

RESPIRATORY DEPRESSANTS: Medicines which lower the action of the respiratory center.

RESPIRATORY STIMULANTS: Medicines which exalt the function of the respiratory center in the medulla, quickening and deepening the breathing.

SIALOGOGUES: Medicines which increase the secretion of the salivary glands (the secretion of the mouth).

SOPORIFICS: Hypnotics.

SPECIFICS: Medicines which have a direct curative influence on certain individual diseases.

STOMACHICS OR GASTRIC TONICS: Medicines which increase the appetite and promote gastric digestion.

STYPTICS: Medicines or applications to control external hemorrhages.

TENICIDES: Medicines which kill the tapeworm.

TONICS: Medicines which augment gradually and permanently the strength and vital activity of the body or its organs, increasing the vigor of the entire system.

VERMICIDES: Medicines which kill intestinal worms.

VERMIFUGES: Medicines which cause the expulsion of intestinal worms.

VESICAL SEDATIVES: Medicines which lessen the irritability of the bladder, decreasing the desire to urinate, and relieving vesical pain and tenesmus.

VESICAL TONICS: Medicines which increase the tone of the muscular fibers in the wall of the bladder; consequently the power for contracting and expelling the urine is increased.

By what methods are medicines administered? By the mouth, rectum, inhalation, hypodermic injection, intravenous injection, and through the skin by various methods.

Is there any difference in the dose when administered by these different methods? Yes. The dose by mouth is usually considered the normal dose; that by inhalation is the smallest and most rapidly acting; that by hypodermic injection, one-third to one-half that by mouth, acting much more rapidly; that by rectum double that by mouth, requiring three to six times as long to produce the desired effect; that by intravenous injection is almost as immediate in action as when administered by inhalation, and the dose is given according to the condition of the patient.

Upon what condition is the adult dose of medicine based? The individual must be 24 years old, and weigh about 150 pounds. Persons under 24 and over 60 years of age require smaller doses in proportion.

What rules are used for computing the dose for a child? Young's rule, which directs that 12 be added to the age, and the sum be divided by the age to obtain the denominator of a fraction the numerator of which is 1. Thus, 3+12=15, divided by 3 (the age) =5, giving the fraction $\frac{1}{5}$, which is the part of the adult dose to give. Cowling's rule, which directs the age to be taken as the numerator of the fraction, and 24 (the age of adult) as the denominator of the fraction.

Are there any exceptions to these rules? Yes; in the cases of some drugs. Children usually require larger doses of purgatives, diaphoretics, and diuretics, and smaller doses of narcotics than the rule.

What conditions of the individual influence the action of drugs?

(1) Sex—females usually require smaller doses than males.

(2) Race—negroes usually require larger (Asiatics smaller) doses than white people.

(3) Physical condition—strong, burly patients require larger doses than weak patients.

(4) Temperament—sanguine temperaments require smaller doses of stimulants than phlegmatic temperaments (sanguine—ardent, cheerful, full-blooded; plegmatic—heavy, dull, stolid, apathetic).

(5) Idiosyncrasy—this is the peculiarity of the individual, and refers to the tolerance or intolerance of some drugs (e. g., some patients are thrown into convulsions by a small dose of an anodyne when given to relieve pain and produce sleep; some can not tolerate at all the action of some drugs).

(6) Climate—warm climates demand smaller doses of purgatives and larger doses of antiperiodics.

(7) Occupation—men working out of doors at hard labor will require larger doses than a clerk who sits at a desk all day.

(8) Habitual use—this modifies the dose by lessening the medicinal power of the drug, and the dose must be increased greatly to obtain a medicinal effect (opium, morphin, and cocain users).

(9) Disease—diseased conditions modify the dose, as in tetanus and peritonitis, when larger doses of narcotics are tolerated.

(10) Form of the drug—this controls largely the rate of absorption, as all substances must be reduced to solution before entering the circulation.

Enumerate the medicinal substances on the Supply Table of the Medical Department, United States Navy, and give their principal properties, uses, and dosage.

Acacia (gum arabic). A gummy exudation from acacia trees (*Acacia senegal*, family *Leguminosæ*, Africa and India). Gathered in the form of tears or fragments; supplied in the form of a white granular powder. Used as a demulcent and an emulsifying agent; also as an excipient in the official troches, pills, etc. Nonpoisonous, but constipating.

Acetphenetidinum (acetphenetidin, phenacetin). A phenol derivative prepared by an elaborate process in which phenol is

acted upon by nitric acid. White, glistening powder or scales; odorless; tasteless; almost insoluble in water. Antipyretic, analgesic, cardiac depressant. Largely used in headache remedies. Dose, 0.2 to 0.65 gm. (3 to 10 grains).

Acetylsalicylic Acid (aspirin). An acetic-acid ester of salicylic acid. White, crystalline powder. Prepared synthetically by a patented process. Antirheumatic, analgesic, antipyretic. A valuable remedy in the treatment of rheumatic conditions, especially when pain is a symptom; headache and intestinal fermentation; is also diuretic. Dose, 0.3 to 1.3 gm. (5 to 20 grains).

Acidum Aceticum Glaciale (glacial acetic acid, 99 per cent). Now issued in place of the 36 per cent acetic acid, U. S. P. Clear, colorless liquid, having an intensely strong, vinegarlike, irritating odor; pure acid taste and acid reaction. Made by subjecting oak wood to destructive distillation and purifying the resulting liquid. Rarely used internally, but is largely used for preparing the official vinegars, acetates, and some liniments; also used as a reagent in urinalysis. Acidum Aceticum Dilutum (diluted acetic acid, U. S. P.) is the official vinegar, and is sometimes given as a diuretic. Dose of the diluted acetic acid, 4 mils (1 fluidram).

Acidum Benzoicum (benzoic acid, flowers of benzoin). Obtained by subjecting gum benzoin to sublimation and synthetically from the urine of cattle. An ingredient in camphorated tincture of opium. Combined with the alkalis it forms the benzoates, which are used as preservatives and administered to relieve intestinal fermentation. Dose, 0.2 to 0.65 gm. (3 to 10 grains).

Acidum Boricum (boric acid, boracic acid). Obtained from sodium borate, which is mined in large quantities in the Pacific States, by decomposition with sulphuric acid, evaporating, crystallizing, and is supplied in the form of a very fine powder. Little used internally. Used externally as a dusting powder and in solution as a cleansing and weakly antiseptic lotion. Dose, 0.3 to 1 gm. (5 to 15 grains).

Acidum Citricum (citric acid). Large colorless crystals obtained from the juice of lemons, limes, etc. Used to prepare those salts known as citrates; enters into the preparation of many effervescent salts. Administered as a refrigerant and as a preventive of scurvy. Dose, 0.3 to 2 gm. (5 to 30 grains).

Acidum Hydrochloricum (hydrochloric acid, HCl, muriatic acid, spirit of salt). Made by decomposing common salt with sulphuric acid, washing, and dissolving the gas in water. A colorless, fuming liquid, having a suffocating, pungent odor and very acid taste. Given in some forms of gastric indigestion, *highly diluted.* The official diluted HCl (10 per cent) is given in doses of 0.3 to 2 mils (5 to 30 minims) in water, and should be taken through a glass tube.

Acidum Nitricum (nitric acid, aqua fortis). Made by decomposing sodium nitrate with sulphuric acid. A colorless, fuming liquid with suffocating odor, very caustic and corrosive, and strongly acid taste.

Acidum Picricum (picric acid, trinitrophenol). Fine, bright yellow, needle-shaped crystals or crystalline powder. Made by adding pure phenol to strong sulphuric acid and then adding nitric acid, purifying, and crystallizing. Used as a test for albumin in urine and in the treatment of burns in saturated solution. Not used internally.

Acidum Salicylicum (salicylic acid). Light, fine, white prismatic needles or white crystalline powder. Native in oil of gaultheria and several other oils from the same family, but made synthetically from sodium phenol. Used as an antipyretic and antiseptic, principally in the treatment of rheumatism and gout. It is the acid radical in all salicylates. Dose, 0.3 to 2 gm. (5 to 30 grains).

Acidum Sulphuricum (sulphuric acid, oil of vitriol). Made by vaporizing sulphur, mixing these fumes with nitrous fumes and steam, and purifying by redistillation. A colorless, oily liquid, without odor, an intensely acid burning taste, and highly corrosive. Mixed with water or alcohol it produces great heat. Used in indigestion, cholera, and diarrhea. The official *diluted*

sulphuric acid is the form in which it is administered, in doses of 0.3 to 2 mils (5 to 30 minims).

Acidum Sulphuricum Aromaticum (aromatic sulphuric acid, elixir of vitriol). The best form in which to administer this acid. Made by mixing 109 mils of sulphuric acid with 50 mils of tincture of ginger, 1 mil of oil of cinnamon, and sufficient alcohol to measure 1,000 mils of finished product. Given for the same purposes and in the same dose as diluted sulphuric acid.

Acidum Tannicum (tannic acid, tannin, gallotannic acid, digallic acid). A light, yellowish, noncrystalline powder, or spongy masses, turning darker on exposure to light and air. Obtained from nutgalls or oak bark. It is used as a powerful astringent. Converted into gallic acid in the intestines, and when so converted is absorbed to act as a systemic astringent for the control of hemorrhages. Powerfully styptic locally. Dose, 0.2 to 0.65 gm. (3 to 10 grains).

Acidum Tartaricum (tartaric acid). Large, colorless prisms or fine white powder. Obtained from the deposit in wine casks by treating with chalk and then with sulphuric acid and crystallizing. One of the ingredients in Seidlitz powder (pulvis effervescens compositus). Used also in many of the effervescent salts and effervescent drinks. Dose, 0.3 to 2 gm. (5 to 30 grains).

Adeps Benzoinatus (benzoinated lard). Prepared by melting pure hog's lard and keeping 2 per cent of its weight of gum benzoin in it, while melted, for two hours. Used as an ointment base. The benzoin is added as a preservative to prevent rancidity. Will permit the incorporation of 20 per cent of its weight of water with it.

Adeps Lanæ Hydrosus (hydrated wool fat, lanolin). The purified fat or grease obtained from sheep's wool and which has had incorporated with it not more than 30 per cent of water. Used as an ointment base. Anhydrous wool fat will permit 100 per cent of its weight of water to be incorporated with it.

Æther (ether, incorrectly called sulphuric ether). A transparent, colorless, volatile liquid. Made by acting on alcohol

with sulphuric acid and distilling. Very inflammable. Used in pharmacy as a solvent; in surgery as a general anesthetic, by inhalation, or a local anesthetic when sprayed upon the part; in medicine as a cardiac stimulant, carminative, and antispasmodic. Dose, 0.3 to 4 mils (5 to 60 minims).

Aetheris Spiritus Compositus (compound spirit of ether, Hoffmann's anodyne). A solution in alcohol of ether and ethereal oil. Used as an anodyne and hypnotic. Does, 0.3 to 8 mils (5 minims to 2 fluidrams).

Aetheris Spiritus Nitrosi (spirit of nitrous ether, sweet spirit of niter). An alcoholic solution of ethyl nitrite, prepared by adding a solution of sodium nitrite to a mixture of sulphuric acid and alcohol, and when the reaction is completed neutralizing the solution, separating, and mixing immediately with twenty-two times its weight of alcohol. Used as a diuretic, diaphoretic, antipyretic, and carminative. Dose, 2 to 8 mils (½ to 2 fluidrams).

Aethylis Chloridum (ethyl chlorid). A colorless, very volatile liquid, made by distilling a mixture of equal volumes of hydrochloric acid and alcohol, and condensing with ice or snow around the receiver. Used as a spray to produce local anesthesia, and as a general anesthetic by inhalation.

Alumen (alum, potassium alum, aluminum and potassium sulphate). Made principally from aluminum clay by treating it with sulphuric acid and then adding potassium sulphate, forming the double salt. Large prismatic crystals, colorless, and having a strongly astringent taste. Supplied in the form of fine white powder. Used as an astringent, both internally and in the form of gargles and lotions. Dose, 0.3 to 2 gm. (5 to 30 grains). Used also as an emetic in doses of 4 gm. (1 dram).

Ammoniæ Aqua Fortior (stronger ammonia water). A colorless, transparent liquid, having an excessively pungent and penetrating odor, caustic and alkaline taste, and strongly alkaline reaction. Obtained from the ammonia liquor produced in the manufacture of coal gas. Used as a vesicant, and to prepare the 10 per cent ammonia water. This preparation contains 28 per cent by weight of ammonia gas.

Ammoniæ Spiritus Aromaticus (aromatic spirit of ammonia). Ammonium carbonate is dissolved in ammonia water and water, and after 12 hours is added to an alcoholic solution of the oils of lemon, nutmeg, and lavender flowers; after mixing, the solution is allowed to stand for 24 hours, and then filtered. Used as a stimulant and antacid, well diluted. Dose, 1 to 4 mils (15 to 60 minims).

Ammonii Carbonas (ammonium carbonate, sal volatile). White, hard, translucent masses, having a strong odor of ammonia, sharp saline taste, and alkaline reaction. Made by the dry sublimation of ammonium sulphate with chalk. Used as a stimulant expectorant and as heart stimulant. Dose, 0.1 to 0.3 gm. (2 to 5 grains).

Ammonii Chloridum (ammonium chlorid, sal ammoniac). White crystalline powder or fine granular crystals. Made chiefly from gas liquor by neutralizing with hydrochloric acid and subliming. Used as a stimulant expectorant. Dose, 0.2 to 0.5 gm. (3 to 8 grains).

Amylis Nitris (amyl nitrite). A clear yellowish liquid, supplied in the form of 5-minim pearls or glass bulbs. Used in asthma, angina pectoris, and similar diseases to relax spasms, by inhaling the vapor from cotton or a handkerchief in which one of the pearls has been crushed.

Antimonii et Potassii Tartras (antimony and potassium tartrate, tartar emetic). Usually in the form of a white granular powder. Made by adding to a boiling solution of antimony oxid sufficient potassium bitartrate to neutralize, filtering the solution, evaporating, and crystallizing. Used as an expectorant, diaphoretic, and emetic. Dose as an expectorant and diaphoretic. 0.002 to 0.008 gm. ($\frac{1}{30}$ to $\frac{1}{8}$ grain); as an emetic, 0.03 to 0.065 gm. ($\frac{1}{2}$ to 1 grain).

Antipyrina (antipyrin). Colorless crystals or white crystalline powder. Made by a synthetic process. Analgesic, antipyretic, diaphoretic, and cardiac depressant. Dose, 0.1 to 0.65 gm. (2 to 10 grains).

Aqua Hydrogenii Dioxidi (hydrogen dioxid water, hydrogen peroxid, H_2O_2). A 3 per cent permanent solution containing about

10 volumes of available oxygen. Prepared by decomposing barium peroxid with phosphoric acid in the presence of water, the water taking up the oxygen set free and forming H_2O_2, and the solution rendered very slightly acid by adding a few drops of diluted sulphuric acid. Antiseptic and disinfectant, especially in the treatment of infected wounds, ulcers, etc.; also in sprays for inflammatory conditions of the nose and throat. Sometimes given internally in the treatment of excessively acid conditions of the stomach in doses of 3 to 4 mils (40 to 60 minims).

Argenti Nitras (silver nitrate). Colorless flat crystals, becoming gray or grayish black on exposure to light and air or in the presence of organic matter. Made by dissolving pure silver in nitric acid, evaporating, and crystallizing. Used externally as a caustic and stimulant to tissues that heal slowly; internally as an astringent and stimulant in the treatment of gastritis and diarrhea. Dose, 0.008 to 0.032 gm. ($\frac{1}{8}$ to $\frac{1}{2}$ grain). Must be used with great caution, as it is a powerful poison.

Argenti Nitras Fusus (fused silver nitrate, lunar caustic, molded stick caustic). Made by adding 4 per cent of hydrochloric acid to silver nitrate, melting at as low a temperature as possible, and pouring into molds. Used externally only as a caustic.

Argyrol (silver vitellin). An albuminous salt of silver, made by a patented process. Contains about 30 per cent of metallic silver. In the form of brownish-black scales or powder. Freely soluble in water. Used in the treatment of gonorrheal infections of all kinds; 10 per cent to 50 per cent solutions for urethral injections and instillation into the eye; 1/2000 to 1/5000 solutions for irrigations of the bladder. Fifty per cent solutions have produced no irritation or pain. Not used internally.

Balsamum Peruvianum (balsam of Peru). A substance of similar consistence to thick molasses, containing resin, volatile oil, and cinnamic acid. Used locally in the treatment of chronic indolent ulcers, local tuberculosis (of the skin, bone, larynx, etc.), and internally in the treatment of chronic catarrhal

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conditions, asthma, syphilis, etc. Dose, 0.3 to 1 mil (5 to 15 minims) diffused in water, sirup, or emulsion.

Belladonnæ Emplastrum (belladonna plaster). Machine-spread plasters, made by mixing 30 per cent extract of belladonna leaves with 70 per cent adhesive plaster in a suitable vessel and spreading upon muslin. Used as an anodyne application in neuralgic and rheumatic affections.

Belladonnæ Extractum Foliorum (extract of belladonna leaves). This is one of the extracts of pilular consistence, and is dark green in color. Used as a sedative, narcotic, diuretic, mydriatic, and antispasmodic, and to diminish the secretions of the mucous glands and membranes. Dose, 0.006 to 0.032 gm. (1/10 to 1/2 grain).

Benzoini Tinctura Composita (compound tincture of benzoin, friars' balsam, Turlington's balsam). A dark brown alcoholic liquid. Made by dissolving benzoin, purified aloes, storax, and balsam of tolu in alcohol and filtering. Used as an expectorant and inhalant. Dose, 2 to 8 mils (1/2 to 2 fluidrams).

Bismuthi Subgallas (bismuth subgallate, dermatol). A bright yellow powder, made by triturating bismuth trioxid with water, gallic acid is added in excess, the mixture allowed to stand 24 hours, and the precipitate washed and dried. Used as a sedative astringent in diarrhea and dysentery, and externally as a drying, astringent, dusting powder in the treatment of ulcers and wounds. Dose, 0.32 to 1.33 gm. (5 to 20 grains).

Bismuthi Subnitras (bismuth subnitrate). Heavy white powder, made by dissolving metallic bismuth in nitric acid, treating with sodium carbonate and ammonia water to free it from arsenical impurities, redissolving in nitric acid, and precipitating the pure bismuth subnitrate by pouring the solution into water; the precipitate is then collected, washed, and dried. Used internally as a sedative astringent in the treatment of intestinal and gastric disorders, especially diarrhea and putrefactive conditions. Dose, 0.32 to 2.00 gm. (5 to 30 grains). It acts mechanically by forming a coating over the inflamed areas. Used also as a dusting powder in the treatment of ulcers.

Buchu Fluidextractum (fluidextract of buchu). Made from buchu leaves. Dark green alcoholic liquid. Used as a tonic, astringent, and disinfectant to the urinary tract. Dose, 1 to 4 mils (15 to 60 minims).

Caffeina Citrata (citrated caffein). Caffein, the principle obtained from coffee and tea (and very feebly basic), is mixed with an equal weight of citric acid, dissolved in water, the solution evaporated to dryness, and the resulting solid reduced to a fine powder. Used as a cardiac and cerebral stimulant, and as a diuretic. Very valuable in narcotism to produce wakefulness. Dose, 0.032 to 0.32 gm. (½ to 5 grains).

Camphora (camphor). A stearopten (solid volatile oil) obtained from the camphor trees and purified by sublimation. White, translucent masses, readily soluble in alcohol, ether, and chloroform; sparingly soluble in water. Used principally externally, but sometimes given internally as an antispasmodic, stimulant, and carminative. Dose, 0.1 to 0.5 gm. (2 to 8 grains).

Capsici Emplastrum (capsicum plaster). Made by applying oleoresin of capsicum to the surface of adhesive plaster (0.25 gm. to each 15 cm. square), and drying. Used as a rubefacient.

Capsici Fluidextractum (fluidextract of capsicum). Made from the ripe fruit of the African cayenne pepper. Used as a stomachic stimulant and carminative, and as a condiment. Stimulates the secretions of the salivary, gastric, and intestinal glands. Dose, 0.032 to 0.20 mil (½ to 3 minims). Applied externally as a rubefacient.

Cardamomi Tinctura Composita (compound tincture of cardamom). A 6 per cent tincture made with diluted alcohol and aromatics. It is used as a carminative and as a flavor. Dose, 2 to 4 mils (½ to 1 fluidram).

Caryophylli Oleum (oil of cloves). A volatile oil distilled from the dried flower buds of *Eugenia aromatica*, and must yield (by assay) not less than 80 per cent of eugenol. A colorless or pale yellow, thin, oily liquid, that becomes thicker and darker by age. Used as an aromatic and as an anesthetic application in toothache. Also in microscopy, to clear tissues for mounting. Dose, 0.065 to 0.20 mil (1 to 3 minims).

Cataplasma Kaolini (cataplasm of kaolin, clay poultice). A substitute for antiphlogistine. Contains kaolin, boric acid, and glycerin, with thymol, methyl salicylate, and oil of peppermint. Must be thoroughly and carefully mixed. Applied to local inflammation where a poultice is desired. Used by many in pneumonia and articular rheumatism.

Chloralum Hydratum (hydrated chloral, chloral hydrate). Colorless rhomboidal crystals, very volatile and deliquescent. Made by treating absolute alcohol with chlorin gas for six or eight weeks, then with sulphuric acid; then mixing with the necessary amount of water and crystallizing. Used as a powerful nervous sedative, in nervous insomnia, hysteria, and the various forms of insanity. Also in delirium tremens, tetanus, and strychnin poisoning. Dose, 0.32 to 1.30 gm. (5 to 20 grains). In tetanus and strychnin poisoning it may be given in three or four times this maximum dose, and repeated in four or five hours.

Chloroformum (chloroform). A heavy, colorless, volatile liquid, made by reacting on acetone with chlorinated lime. Used externally as a rubefacient and vesicant; in surgery as a general anesthetic by inhalation; internally as a carminative and sedative. Dose, 0.18 to 0.49 mil. (3 to 8 minims). In large doses it is a powerful narcotic, and acts also as an irritant.

Cinchonæ Tinctura Composita (compound tincture of cinchona). A tincture made with 67.5 per cent alcohol, 7.5 per cent glycerin, and 25 per cent water as a menstruum, and containing the soluble principles of 10 per cent red cinchona bark, 8 per cent bitter orange peel, and 2 per cent serpentaria root. Commonly called tincture of red bark, Huxham's tincture, etc. A valuable bitter tonic, often used in the treatment of malaria. Dose, 2 to 8 mils (½ to 2 fluidrams).

Cocainæ Hydrochloridum (cocain hydrochlorid). The neutral hydrochlorid of an alkaloid obtained from several species of coca. Colorless, transparent prisms, flaky, lustrous leaflets, or white crystalline powder. Freely soluble in water. Largely used as a local anesthetic, mydriatic, and cerebral stimulant.

For local anesthesia, 2 per cent to 4 per cent solutions are most frequently used, though sometimes the strength may vary from one-fourth of 1 per cent to 10 per cent. As a mydriatic its effect is brief, the dilatation passing away in four to eight hours, and no paralysis of accommodation is produced. Dose, 0.016 to 0.032 gm. (¼ to ½ grain).

Codeina (codein). An alkaloid obtained from opium, and is also prepared from morphin by methylation. White, prismatic crystals or crystalline powder. Used largely as a sedative in the treatment of coughs to lessen the irritation in the respiratory tract. Of great value in the cough of tuberculosis. Dose, 0.016 to 0.064 gm. (¼ to 1 grain).

Collodium Cantharidatum (cantharidal collodion, blistering collodion). A yellowish-green liquid, having an ethereal odor. Made by treating cantharides with chloroform until exhausted, evaporating off the chloroform, and dissolving the residue in flexible collodion. Used externally only as a blistering agent.

Collodium Flexile (flexible collodion). A pale yellowish or colorless liquid of sirupy consistence, having an ethereal odor. Made by dissolving pyroxylin (one of the guncottons) in ether and alcohol. Used externally only to form a noncontractile film over abrasions and to attach small dressings; also to bring medicinal substances into contact with the skin.

Creosoti Carbonas (creosote carbonate, creosotal). A very thick, sirupy liquid, pale yellow in color. Employed in the treatment of pneumonia and some forms of gastric disturbances, as it is much less irritating than creosote. Dose, 0.5 to 1 mil (8 to 15 minims).

Creosotum (creosote). A mixture of phenols and phenol derivatives, chiefly guaiacol and creosol, obtained by the distillation of wood tar, preferably that derived from beechwood, hence the name "beechwood creosote." An almost colorless, yellowish, oily liquid; must have no pink tinge. Antiseptic, caustic, anesthetic when applied locally, and antiemetic. It possesses the property of preserving tissues. Because of its caustic properties it is a powerful irritant poison. Given in doses of 0.032 to 0.33 mil (½ to 5 minims) in the treatment

of gastric disorders; in doses of 0.33 to 1 mil (5 to 15 minims) (beginning with a small dose and gradually increasing) in the treatment of tuberculosis.

Eucainæ Hydrochloridum (eucain hydrochlorid). A preparation made synthetically. Used to replace cocain hydrochlorid, as it is considered less toxic as a local anesthetic. Does not dilate the pupil, and its solutions can be sterilized by boiling. Solutions for the eye, 1 per cent to 2 per cent; for mucous surfaces, 2 per cent to 5 per cent.

Eucalyptol. An organic oxid (cineol) obtained from the volatile oil of eucalyptus. Colorless oily liquid, characteristic odor, and burning taste. Used in the official liquor antisepticus, and is given internally in catarrhal conditions of the mucous membranes, both respiratory and genito-urinary. Dose, 0.06 to 0.5 mil (1 to 8 minims).

Ferri Chloridi Tinctura (tincture of ferric chlorid, tincture of iron). A bright brownish liquid, made by diluting 350 mils of solution of ferric chlorid with 650 mils alcohol, and allowing the mixture of liquids to stand in a closely covered vessel in a cool place for at least three months. Then transfer to glass-stoppered bottles. The object of allowing this liquid to remain for three months before using is to allow the development of ethereal compounds, which are supposed to give this preparation its diuretic properties. Used as a chalybeate tonic and styptic. Dose, 0.65 to 2.50 mils (10 to 40 minims) well diluted, through a tube to protect the teeth.

Ferri et Quininæ Citras (citrate of iron and quinin). Thin, transparent scales of a greenish, golden-yellow color, odorless, with a ferruginous taste. Deliquescent. Made by adding to a solution of ferric citrate, quinin, citric acid, and treating with ammonia water; then evaporating to the consistence of a sirup and pouring on glass plates to dry, that it may be obtained in scale form. Chalybeate tonic. Dose, 0.20 to 0.65 gm. (3 to 10 grains).

Creta Preparata (prepared chalk, drop chalk). This is native calcium carbonate freed from most of its impurities by elutriation. A white, or grayish-white, fine powder, often

molded into cones. Used as an ingredient in chalk mixture and compound chalk powder in the treatment of diarrhea, and as an antacid. Dose, 0.33 to 4 gm. (5 to 60 grains).

Cupri Sulphas (copper sulphate, blue vitriol, bluestone). Large, deep-blue crystals, or pale-blue crystalline powder. Made by dissolving metallic copper in diluted sulphuric acid, evaporating and crystallizing. Used as an emetic, astringent, and phosphorus antidote when given internally. As a caustic when applied externally. Dose as an emetic, 0.33 gm. (5 grains), which may be repeated once only after 15 minutes; as an astringent, 0.008 to 0.032 gm. (one-eighth to one-half grain); as an antidote to phosphorus, same as for emetic.

Digitalis Tinctura (tincture of digitalis). Prepared from leaves gathered from plants of the second year's growth at the commencement of flowering. Powerful cardiac stimulant, producing greater force of contractions of the heart muscle, and reducing number of beats per minute, with increased arterial presure. Because of this increased arterial pressure it acts as a powerful diuretic. Dose, 0.33 to 1 mil (5 to 15 minims).

Ergotæ Fluidextractum (fluid extract of ergot). Prepared from ergot of rye (a fungous growth that replaces the grain of rye) that has been recently ground and is less than 1 year old. Menstruum is diluted alcohol to which 2 per cent acetic acid has been added, to fix the alkaloids in solution, and to extract them from the oil, all of which is not dissolved in the menstruum. Used internally in the treatment of hemorrhage, as it is a powerful vasoconstrictor. It also acts powerfully upon the uterus. Dose, 1 to 4 mils (15 to 60 minims).

Ferri Pyrophosphas Solubilis (soluble ferric pyrophosphate). Thin, apple-green, transparent scales. Made by treating ferric citrate with sodium pyrophosphate in solution and making in scale form as other scale salts of iron. Mild chalybeate tonic. Dose, 0.065 to 0.33 gm. (1 to 5 grains).

Gentianæ Tinctura Composita (compound tincture of gentian). Prepared from gentian root, cardamom, and bitter orange peel, the menstruum being alcohol 600 mils and water 400 mils.

A valuable bitter tonic, largely employed both alone and as a vehicle for more potent tinctures. Dose, 2 to 8 mils (1½ to 2 fluidrams).

Glandulæ Suprarenales Extractum (suprarenal extract, solution of adrenalin chlorid, 1/1000 solution). A solution prepared from the dried, prepared suprarenal glands of sheep or ox which have been treated with hydrochloric acid and diluted with normal salt solution to a 1/1000 solution. Powerful cardiac stimulant and vasoconstrictor. Used in minor surgery to render the tissue bloodless, especially in operations on the nose and throat. Dose, as a heart stimulant, 0.33 to 0.65 mil (5 to 10 minims).

Glycerinum (glycerin). A clear, colorless liquid, thick and sirupy, with a sweet taste, producing a sensation of warmth in the mouth. Obtained by the decomposition of fats and fixed oils in soap making and the preparation of lead plaster. It is a valuable solvent and antiseptic. As it absorbs moisture from the air, it tends to keep substances from becoming hard.

Glycyrrhizæ Extractum Pulvis (powdered extract of glycyrrhiza (licorice)). The extract of the root of *Glycyrrhiza glabra*, reduced to fine powder. A dark brown powder having a very sweet taste. Used as a demulcent and for the administration of bitter medicines to mask their taste. Nonpoisonous. One of the ingredients in compound mixture of glycyrrhiza.

Glycyrrhizæ Pulvis Compositus (compound powder of glycyrrhiza, compound licorice powder). One of the official powders, containing senna, glycyrrhiza, washed sulphur, sugar, all in fine powder, to which is added oil of fennel, and the whole uniformly mixed. Used as a mild laxative (especially valuable in the treatment of the constipation occurring in cases of hemorrhoids) and as a purgative. Dose, 4 to 8 gm. (1 to 2 drams).

Gossypii Seminis Oleum (cottonseed oil). A fixed oil expressed from cotton seed. Used in liniments. Will not saponify with limewater. A pale yellow, oily liquid. Dose, 4 to 15 mils (1 to 4 fluidrams).

Guaiacol. Colorless solid or liquid (crystalline solid below 28 C.) and is one of the chief constituents of creosote. Also prepared synthetically. Its internal use is for the same conditions as require the administration of phenol. Applied to the skin, 1 to 3 mils painted on the thigh, chest, or abdomen, it acts as an antipyretic, the temperature having been known to fall several degrees in an hour. Its effect is temporary.

Hexamethylenamina (hexamethylenamin, urotropin, formin). Obtained by the action of ammonia upon formaldehyd. Powerful diuretic, antiseptic, and disinfectant to the genito-urinary tract. Of special value in the treatment of cystitis of gonorrheal origin and as an eliminant for uric acid. Dose, 0.33 to 1.30 gm. (5 to 20 grains), well diluted.

Homatropinæ Hydrobromidum (homatropin hydrobromid). The hydrobromid of an alkaloid artificially produced from atropin. Used as a substitute for atropin and its salts in ophthalmic practice for producing mydriasis, as its effects are not so violent or long lasting. Used in solutions varying in strength from 1/240 to 1/60. Complete dilatation of the pupil with paralysis of accommodation will be produced by five or six instillations in an hour of a 1 per cent solution; this effect will entirely pass off in 20 to 30 hours.

Hydrargyri Chloridum Corrosivum (corrosive chlorid of mercury, bichlorid, corrosive sublimate). Heavy, colorless crystals or crystalline masses. Made by mixing sulphate of mercury with common salt and subliming. Used internally as a tonic, alterative, and antisyphilitic; externally as an antiseptic and disinfectant. Dose, 0.001 to 0.008 gm. ($\frac{1}{60}$ to $\frac{1}{8}$ grain.)

Hydrargyri Chloridum Mite (mild chlorid of mercury, calomel). A white, heavy, impalpable powder, becoming yellowish white upon being triturated with strong pressure. Made by mixing metallic mercury with mercuric sulphate, then with common salt, and subjecting the mixture to sublimation, and washing the sublimate to remove mercuric chlorid. Used internally as a purgative and cholagogue and as an alterative; externally as a dusting powder and in ointments (10 per cent to 50 per cent) in venereal prophylaxis and in the treatment of vario

skin diseases. Dose, 0.0065 to 0.65 gm. (1/10 to 10 grains). Calomel that has become grayish or blackish in color should not be used, as it has deteriorated and is impure.

Hydrargyri Massa (mass of mercury, blue mass, blue pill). Made by triturating 33 per cent of metallic mercury with glycerin and honey of rose and adding althea and glycyrrhiza (both in the form of fine powder) to reduce the finished product to a pilular consistence, the whole being uniformly mixed. A valuable alterative, as well as one of the forms in which mercury is administered as a purgative and cholagogue. Dose as an alterative, 0.032 to 0.065 gm. (½ to 1 grain); as a purgative and cholagogue 0.2 to 0.65 gm. (3 to 10 grains).

Hydrargyri Nitratis Unguentum (ointment of nitrate of mercury, citrine ointment). Made by incorporating a solution of metallic mercury in nitric acid with lard which has had nitric acid added to it and, after the reaction has ceased, stirring until cool. Used in various skin diseases and in the treatment of inflamed eyelids.

Hydrargyri Oleatum (oleate of mercury). Made by treating yellow mercuric oxid with oleic acid, and is used externally only as a substitute for mercurial ointment. It is more readily absorbed by the skin, but is not as easily preserved as the ointment. Strength, 25 per cent.

Hydrargyri Oxidum Flavum (yellow mercuric oxid). A light orange-yellow, heavy, impalpable powder. Made by treating corrosive mercuric chlorid in solution with solution of sodium hydroxid, collecting, washing, and drying the precipitate. Used externally only in the treatment of ulcers and ulcerated eyelids in the form of ointment, usually in the proportion of 1 grain to 2 drams of petrolatum or wool fat.

Hydrargyri Salicylas (mercuric salicylate). Used as an alterative in the treatment of syphilis, as it is less irritant to the alimentary tract than other compounds of mercury; also given by intramuscular injection, which produces no local irritation and brings the system rapidly under the influence of mercury. Dose, 0.016 to 0.065 gm. (¼ to 1 grain).

Hydrargyri Unguentum (ointment of mercury, mercurial ointment, blue ointment). Made by extinguishing 500 gm. metallic mercury with 20 gm. oleate of mercury, then incorporating with 250 gm. benzoinated lard and 230 gm. prepared suet which have previously been melted. The object is to obtain the mercury in a very fine state of division for inunction. The mercury must be invisible under a magnifying glass of 10 diameters. Used in the treatment of syphilis and to bring the system under the influence of mercury; also in glandular swellings.

Hydrargyrum Ammoniatum (ammoniated mercury, white precipitate). Prepared by precipitating a solution of mercuric chlorid with ammonia water added to excess and washing and drying at a temperature below 86 F. Used in the treatment of skin diseases, externally only, in the form of ointment.

Hyoscyami Extractum (extract of hyoscyamus, extract of henbane). Prepared by evaporating the fluidextract to pilular consistence at a low heat. Used as a hypnotic, nervous sedative, and analgesic; also in some forms of hysteria and insanity. Dose, 0.032 to 0.13 gm. (½ to 2 grains).

Ichthyol (ammonium sulphoichthyolate). A tarry looking substance, about the consistence of very thick sirup, having a disagreeable odor. Obtained by treating mineral masses found in the Tyrolese Alps containing animal residues of fish, etc. Purified by distillation. Used as an alterative, anodyne discutient, in the form of ointments and lotions, in the treatment of inflammatory conditions. Given internally in intestinal indigestion as an antifermentative. Dose, 0.33 to 1 gm. (5 to 15 grains).

Iodoformum (iodoform, triiodomethane, CHI_3). A fine lemon-yellow crystalline powder. Made by adding iodin to a hot mixture of alcohol, water, and potassium carbonate, then passing a stream of chlorin gas through the mixture, filtering out the iodoform, and drying it in the open air. Used locally as an antiseptic and anesthetic dressing to wounds and ulcers. It is also used internally as an alterative in doses of 0.065 to 0.2 gm.

(1 to 3 grains). It is said to possess some anesthetic properties when applied locally, and is a stimulant.

Iodum (iodin). This element is obtained from sea water (by electrolysis) and various other sources, but principally from the masses of seaweeds obtained from the coasts of Norway. The seaweeds are burned, the ashes lixiviated, and the resulting salts treated to obtain iodin and bromin. Iodin is applied externally as a powerful counterirritant, disinfectant, and parasiticide. Given internally (rarely) as an alterative. Dose, 0.016 to 0.065 gm. ($\frac{1}{4}$ to 1 grain).

Ipecacuanhæ et Opii Pulvis (powder of ipecac and opium, Dover's powder). Made by mixing 10 per cent powdered ipecac with 10 per cent powdered opium and 80 per cent powdered sugar of milk. Must be intimately and uniformly mixed. Used as an anodyne and diaphoretic. Dose, 0.33 to 1 gm. (5 to 15 grains).

Ipecacuanhæ Fluidextractum (fluidextract of ipecac). Used to prepare sirup of ipecac, and is also an ingredient in various cough mixtures and liquid preparations administered in the treatment of gastric indigestion. Acts in doses of 0.003 to 0.006 mil ($\frac{1}{20}$ to $\frac{1}{10}$ minim) as a gastric tonic or stomachic; in doses of 0.032 to 0.1 mil ($\frac{1}{2}$ to 2 minims) as an expectorant; and in doses of 1 to 2 mils (15 to 30 minims) as an emetic.

Ipecacuanhæ Pulvis (powdered ipecac). The root of *Cephaelis ipecacuanha* or *Cephaelis acuminata* (family *Rubiaceæ*) dried and finely powdered. Used for all the purposes for which the fluidextract is prescribed, and also in the treatment of amebic dysentery in doses of 4 to 6 gm. (60 to 90 grains) given on an empty stomach, and every precaution taken to prevent its emetic action.

Lithii Citras (lithium citrate). A fine white powder. Made by neutralizing lithium carbonate with citric acid in solution, evaporating, and drying. Used as an antirheumatic, diuretic, and antilithic, and to remove uric acid from the blood. Given in doses of 0.65 to 2 gm. (10 to 30 grains).

Magnesii Oxidum (magnesium oxid, magnesia). A white, very bulky, and very fine powder. Made by calcining mag-

nesium carbonate. Used as an antacid and laxative. Dose, 0.65 to 4 gm. (10 to 60 grains).

Magnesii Sulphas (magnesium sulphate, Epsom salt). Small, prismatic, needle-shaped crystals. Colorless and odorless. Made by treating native magnesium oxid with sulphuric acid. Used very largely as a cathartic and laxative. One of the saline purgatives. Dose, 5 to 30 gm. (⅙ to 1 oz.).

Menthae Piperitæ Oleum (oil of peppermint). A volatile oil distilled from the leaves and flowering tops of peppermint. A colorless, oily liquid, having a pure mint odor and taste. Used as a flavor, as a stimulant, and carminative. Dose, 0.065 to 0.33 mil (1 to 5 minims). It is the active ingredient in spirit of peppermint.

Menthol. A stearopten obtained from oil of peppermint by fractional distillation. Colorless, prismatic or needle-shaped crystals. An ingredient in the oil sprays for the nose and throat, and locally as an anodyne application in the treatment of neuralgic pains.

Methylis Salicylas (methyl salicylate, oil of gaultheria, oil of wintergreen, oil of teaberry). A volatile oil distilled from the leaves of *Gaultheria procumbens*. A colorless or pale yellow, oily liquid, having a fragrant odor and burning taste. Prepared synthetically by distilling salicylic acid or a salicylate with methyl alcohol and strong sulphuric acid. Used as a flavor and in the treatment of rheumatism both locally and internally. Dose, 0.33 to 1.3 mils (5 to 20 minims).

Morphinæ Diacetyl Hydrochloridum (morphin diacetyl hydrochlorid, heroin hydrochlorid). The hydrochlorid of a derivative alkaloid of morphin. Used as a sedative in the treatment of tubercular coughs it is said to lessen the severity of the paroxysms, and also the sweating. Dose, 0.002 to 0.008 gm. ($\frac{1}{30}$ to ⅛ grain).

Morphinæ Sulphas (morphin sulphate). A sulphate of the principal alkaloid obtained from opium. White, feathery, silky, crystals or masses. Odorless, but having a bitter, nauseous taste. Used largely as a sedative, analgesic, hypnotic, diaphoretic, and antispasmodic. It is also powerfully narcotic. Given

in doses of 0.008 to 0.32 gm. ($\frac{1}{8}$ to $\frac{1}{2}$ grain). (Persons in the habit of using this drug often take enormous doses.)

Morrhuæ Oleum (codliver oil). A fixed oil expressed from the fresh livers of the cod, hake, haddock, etc. A pale yellow, oily liquid. Used in the treatment of wasting diseases to increase red blood corpuscles, body weight, and healthy cell formation. Dose, 4 to 15 mils (1 to 4 fluidrams), either plain or in emulsion.

Myrrhæ Tinctura (tincture of myrrh). A dark brown, alcoholic liquid. Made by dissolving 200 gm. of myrrh in sufficient alcohol to measure 1 liter. Used principally locally in diseases of inflamed mucous membranes, especially of the mouth, gums, etc., and in ptyalism. An ingredient in toothwashes. Given internally in doses of 0.65 to 4 mils (10 to 60 minims) as an astringent.

Nucis Vomicæ Fluidextractum (fluidextract of nux vomica). Must contain 2.5 per cent alkaloids by assay. Used instead of the extract to prepare the tincture of nux vomica. Given as a stimulant—spinal, cardiac, respiratory, nervous, and muscular—in doses of 0.016 to 0.2 mil ($\frac{1}{4}$ to 3 minims).

Opii Pulvis (powdered opium). A chocolate-colored powder, having a heavy narcotic odor, and bitter, characteristic taste. Powdered opium must contain not less than 10 per cent and not more than 10.5 per cent of crystallizable morphin. Gum opium is the concrete milky exudation obtained by incising the unripe capsules of *Papaver somniferum*. Used for all purposes for which morphin is employed. Dose, 0.032 to 0.13 gm. ($\frac{1}{2}$ to 2 grains).

Opii Tinctura (tincture of opium, laudanum). A dark reddish-brown, alcoholic liquid, containing 10 per cent of opium in diluted alcohol. A convenient form for the administration of opium. Used for all purposes for which morphin is employed. Dose, 0.33 to 1.32 mils (5 to 20 minims).

Opii Tinctura Camphorata (camphorated tincture of opium, paregoric, elixir of opium). The weakest of the preparations of opium, containing 0.4 per cent of opium in diluted alcohol, combined with camphor, benzoic acid, and oil of anise. Used largely as a sedative, hypnotic, analgesic, carminative, and to

diminish secretions of the intestines, as required in some forms of diarrhea. Dose, 1 to 4 mils (15 to 60 minims).

Pepsinum (pepsin). A ferment or enzyme, obtained from the gastric glands of the hog. Used to assist gastric digestion in patients having a deficient secretion of gastric juices. Acts only upon albuminous foods. The Pharmacopeia requires that 1 grain must be capable of digesting 3,000 grains of finely divided coagulated egg albumen. Usually given in solution in doses of 0.065 to 1 gm. (1 to 15 grains). Acts only in an acid medium.

Petrolatum (vaseline, cosmoline, petroleum jelly). A yellowish or light-amber colored ointmentlike mass, having a slight fluorescence, petroleumlike odor and taste. Never becomes rancid, is nonirritating to the skin, but is not as readily absorbed by the skin as lard or wool fat. Will permit 10 per cent of its weight of water or aqueous liquids to be incorporated with it. It is the residue obtained in the distillation of petroleum oils and purified.

Petrolatum Liquidum (liquid petrolatum, mineral oil, Russian oil). A clear, colorless, odorless, and tasteless oily liquid. Obtained in distilling petroleum oils. Used as a basis for the oil sprays for the nose and throat. An ingredient in cantharides cerate. Largely used in the treatment of constipation, especially when there is fermentation. Its action is mechanical, as it is not absorbed, but simply oils the entire digestive tract and facilitates the passage of the fecal mass. Dose, 8 to 30 mils (2 to 8 fluidrams) once or twice daily.

Phenylis Salicylas (phenyl salicylate, salol). Made by a synthetic process whereby the phenol group is made to unite with the salicylic-acid radical. A white crystalline powder, having a distinctive aromatic odor and taste. Used as an intestinal antiseptic, antipyretic, antirheumatic. Dose, 0.33 to 1 gm. (5 to 15 grains).

Physostigminæ Sulphas (physostigmin sulphate, eserin sulphate). The sulphate of an alkaloid obtained from physostigma or Calabar bean (the "ordeal bean" of some native African tribes). Used as a powerful motor depressant (of value in the treatment of poisoning by strychnin and nux vomica) and as

a myotic to counteract the effects of atropin upon the pupil. Dose, 0.0006 to 0.002 gm. (1/100 to 1/30 grain). Solutions for the eye are one-half to 1 per cent.

Plumbi Acetas (lead acetate, sugar of lead). Colorless, shining, transparent prismatic crystals or plates or heavy white crystalline masses. Efflorescent and absorbing carbon dioxid from the air. Made by neutralizing lead oxid with acetic acid, with the aid of heat, evaporating, and crystallizing. Used internally as an astringent in the treatment of diarrhea and externally as a lotion in the treatment of bruises and sprains, as a sedative and astringent. Dose, 0.032 to 0.2 gm. (½ to 3 grains).

Potassii Acetas (potassium acetate). Fine, white, crystalline powder, having a strong odor of vinegar. Prepared by neutralizing potassium hydroxid, potassium carbonate, or potassium bicarbonate with acetic acid, evaporating, and crystallizing. Used as a diuretic, diaphoretic, and laxative, and to render the urine alkaline. It is converted into potassium bicarbonate in the digestive tract. Dose, 0.65 to 4 gm. (10 to 60 grains).

Potassii Arsenitis Liquor (solution of potassium arsenite, Fowler's solution). A light reddish-brown liquid, having a distinctive odor. Contains 1 per cent arsenic trioxid combined in solution with potassium bicarbonate, with the addition of compound tincture of lavender. Used as an alterative and tonic, and in the treatment of the chronic malarial fevers. Dose, 0.065 to 0.3 mil (1 to 5 minims).

Potassii Bicarbonas (potassium bicarbonate). Colorless, small, irregular, flat crystals. Prepared by passing a stream of carbon dioxid into a solution of potassium carbonate, evaporating, and crystallizing. Used as an antacid. Dose, 1 to 4 gm. (15 to 60 grains).

Potassii Bitartras (potassium bitartrate, cream of tartar). White, gritty powder prepared from the deposit found in wine casks, argol. Diuretic and cathartic. Dose, as a diuretic, 0.65 to 4 gm. (10 to 60 grains). Dose, as a cathartic, 4 to 20 gm. (1 to 5 drams).

Potassii Bromidum (potassium bromid). Colorless or white, bical crystals or granular powder. Prepared by reacting on

ferrous bromid with potassium carbonate (both in solution), evaporating, and crystallizing. Used as a nervous sedative and hypnotic. Dose, 0.65 to 4 gm. (10 to 60 grains). In tetanus and strychnin poisoning ½ to 1 ounce may be given at one dose (15 to 30 gm.).

Potassii Chloras (potassium chlorate). Colorless, flat crystals, or white flaky or granular powder. This salt is now made largely by electrolysis. Used as a gargle and in the treatment of scarlet fever, diphtheria, and sore throat. Dose, 0.33 to 1.3 gm. (5 to 20 grains).

Potassii et Sodii Tartras (potassium and sodium tartrate, Rochelle salt). Large, colorless, prismatic crystals or fine white powder. Made by neutralizing potassium bitartrate with sodium carbonate (both in solution), evaporating, and crystallizing. Used as a laxative and cathartic. Dose, 4 to 30 gm. (1 dram to 1 ounce).

Potassii Hydroxidum (potassium hydroxid, potassa, potassium hydrate, caustic potash, potash lye). Obtained from wood ashes and other sources. Small white pencils or sticks. Must be preserved in tightly stoppered bottles, as it absorbs moisture and carbon dioxid from the air. Used externally as a caustic. Internally in the form of the 5 per cent official solution as an antacid. Dose, 0.33 to 2 mils (5 to 30 minims).

Potassii Iodidum (potassium iodid). Colorless or white cubical crystals or white granular powder. Made by treating a solution of potassium hydroxid with iodin in slight excess, evaporating, and exposing the resulting salts to a red heat, dissolving, and crystallizing. Used largely as an alterative in the treatment of syphilis, rheumatism, lead poisoning, etc. Dose, 0.33 gm. (5 grains), gradually increased to as high as 8 gm. (120 grains), three or four times daily.

Protargol. Silver combined with protein. Contains about 8 per cent metallic silver in combination. Used externally principally in gonorrheal infections, in solutions of from one-half to 5 per cent.

Quininæ Chlorhydrosulphas (quinin chlorhydrosulphate). Made by dissolving 10 parts of quinin sulphate in 3.3 parts of 25

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per cent hydrochloric acid, and allowing the solution to crystallize during spontaneous evaporation. Forms colorless crystals soluble in one part of water. Used for the administration of quinin hypodermically, on account of its greater solubility. Contains about 74 per cent of quinin. Dose, 0.065 to 0.2 gm. (1 to 3 grains). Used for the same purposes as quinin and its other salts.

Quininæ Sulphas (quinin sulphate). The sulphate of an alkaloid obtained from cinchona bark. White, silky, glistening crystals, or hard, prismatic needles. Used largely as an antiperiodic, tonic, and antipyretic, especially in the treatment of malarial fevers. Dose, 0.065 to 1.3 gm. (1 to 20 grains).

Resorcinol. A diatomic phenol. Used externally in the treatment of diseases of the skin in the form of ointments or lotions; internally in the treatment of gastric and intestinal catarrh, gastric ulcers, and enteritis. Sometimes used in solutions (1 per cent to 15 per cent) in the treatment of hay-fever, nasal catarrh, chronic otitis, and for washing out the stomach or bladder in diseased conditions of those viscera. Dose, 0.13 to 0.33 gm. (2 to 5 grains).

Ricini Oleum (castor oil). A fixed oil expressed from the seeds of the castor-oil plant. A pale straw-colored liquid, thick and oily. Used as a purgative. Dose, 8 to 45 mils (one-fourth to 1½ fluidounces).

Santali Oleum (sandalwood oil, oil of santal). A volatile oil distilled from the wood of *Santalum album*. Obtained from the East Indies. A pale-yellow, oily liquid, having a peculiar aromatic odor, pungent, spicy taste, and slightly acid reaction. Used as a stimulant, diuretic, disinfectant, and expectorant. Largely used in the treatment of inflammation of the genito-urinary tract, bronchitis, and chronic inflammatory conditions of the mucous membranes. Dose, 0.33 to 1.3 mils (5 to 20 minims).

Sapo (soap, white Castile soap). Soap prepared from sodium hydroxid and olive oil. Used in liniments, plasters, and as a pill excipient for resinous drugs. An ingredient in the official pills of opium.

Sapo Mollis (soft soap, green soap). Soap prepared from potassium hydroxid and linseed oil. A soft, ointmentlike, yellowish-brown mass. Used as a stimulating cleanser.

Saponis Linimentum (soap liniment, liquid opodeldoc). A pale straw-colored liquid, made by dissolving soap, camphor, and oil of rosemary in alcohol and water and filtering the solution. Used as an application to sprains, bruises, rheumatic and other pains. Not used internally.

Sinapis Emplastrum (mustard plaster). An incorrect name for mustard paper, charta sinapis. Made by extracting the fixed oil from ground mustard seed, mixing it with a solution of rubber, and spreading it upon thick, well-sized paper or muslin. It is used as a counterirritant application by dipping the mustard paper in water for a few seconds before applying.

Sinapis Nigra (black mustard). The finely ground seeds of black mustard. Used for the same purposes as the mustard paper when it is desired to apply this remedy over a greater surface or for a longer time. Made into the so-called mustard poultice, either by mixing into a paste with water or by adding a portion of flour to reduce its strength.

Sodii Bicarbonas (sodium bicarbonate, baking soda). Made by passing a stream of carbon-dioxid gas through a solution of sodium carbonate and collecting the precipitate. A white, opaque powder. Used as an antacid. Dose, 0.33 to 4 gm. (5 to 60 grains). In cases of hyperchlorhyria (excessively acid condition of the stomach), as much as 1 ounce may be given at one dose (30 gm.).

Sodii Boras (sodium borate, borax). Colorless, prismatic crystals or white powder, mined in the western part of the United States in large quantities, and purified. Used as a diuretic and antacid (rarely administered). Dose, 0.33 to 2 gm. (5 to 30 grains). Used largely in the making of soaps, to whiten them. An ingredient in many mouth washes, and is sometimes applied to ulcers in the mouth, either in the form of powder or mixed with honey.

Sodii Bromidum (sodium bromid). White granular powder. Prepared in the same manner as potassium bromid, and is used

for the same purpose and in the same doses. It is less depressing than the potassium salt.

Sodii Carbonas Monohydratus (monohydrated sodium carbonate). Sodium carbonate containing 85 per cent of the pure anhydrous salt. Used in the sterilization of instruments. Used internally (rarely) as an antacid. Dose, 0.065 to 0.33 gm. (1 to 5 grains).

Sodii Citras (sodium citrate). White, granular powder, with a cooling, saline taste, odorless, and slightly alkaline reaction. Made by adding sodium carbonate to a solution of citric acid until effervescence ceases, evaporating, and granulating the product. Used as a diaphoretic. Dose, 0.33 to 1 gm. (5 to 15 grains).

Sodii Phosphas (sodium phosphate). Small colorless granular crystals, made by treating the inorganic portion of bones, first with sulphuric acid and then with sodium carbonate, filtering, evaporating, and crystallizing. Used as a laxative and cathartic and hepatic stimulant. Dose as a purgative, 15 to 30 gm. (½ to 1 ounce); as an hepatic stimulant, 2 to 6 gm. (30 to 90 grains).

Sodii Salicylas (sodium salicylate). White powder, having sometimes a faint pink tinge. Prepared by neutralizing solution of sodium carbonate with salicylic acid, evaporating, and powdering. Antirheumatic, analgesic, and antipyretic. Used largely in the treatment of rheumatism, neuralgia, and tonsillitis. Dose, 0.33 to 2 gm. (5 to 30 grains).

Sodii Thiosulphas (sodium thiosulphate, sodium hyposulphite, hypo). Colorless, prismatic crystals. Made by decomposing soluble calcium thiosulphate with solution of sodium hydroxid or sodium carbonate, evaporating, and crystallizing. Used internally (rarely) as an alterative. Used externally in the treatment of some skin diseases. Dose, 0.33 to 2 gm. (5 to 30 grains).

Strophanthi Tinctura (tincture of strophanthus). A 10 per cent tincture. Made by percolation with 65 per cent alcohol. Used for the same purposes as digitalis, but acts directly through the circulation and not primarily through the nerve

centers. Large doses must be used with caution. Dose, 0.1 to 0.5 mil (2 to 8 minims).

Sulphonethylmethanum (sulphonethylmethane, trional). Made synthetically. Colorless, lustrous, crystalline scales. Used as a hypnotic and sedative. Dose, 1 to 2 gm. (15 to 30 grains).

Sulphur Lotum (washed sulphur). Made by treating sublimed sulphur with a weak solution of ammonia water and washing thoroughly to remove all traces of impurities. Used internally as a laxative and diaphoretic and externally in the treatment of skin diseases. Dose, 0.65 to 4 gm. (10 to 60 grains).

Talcum Purificatum (purified talc). A native hydrous magnesium silicate, purified by washing with boiling water to which has been added a small quantity of hydrochloric acid, washing, drying, and pulverizing. Used in the preparation of the official medicated waters and as a clarifying agent. Used externally as a dusting powder.

Terebenum (terebene). A colorless, oily liquid, made by acting on oil of turpentine with sulphuric acid. Valuable as a stimulating expectorant, especially in the treatment of chronic bronchitis. Dose, 0.33 to 1 mil (5 to 15 minims).

Terebinthinae Oleum (oil of turpentine, spirits of turpentine). This is the volatile oil distilled from an exudation from various species of American pine. Used externally in liniments and as a rubefacient. Used internally in chronic bronchial catarrhs, as an expectorant, and in catarrhal conditions of the genitourinary tract. A valuable diuretic, but must be used with caution, as large doses may produce violent irritation of the kidneys. Also as a remedy against worms, usually in the form of an emulsion. Dose, 0.33 to 2 mils (5 to 30 minims).

Theobromatis Oleum (oil of theobroma, butter of cacao). A yellowish-white solid. A fixed oil expressed from the roasted seeds of *Theobroma cacao.* A valuable agent for the preparation of suppositories, as it melts below the normal temperature of the human body. Used sometimes in ointments that are termed "skin foods." Not used internally, though it is nonpoisonous.

Thymol. A phenol obtained from oil of thyme and other volatile oils. Large, colorless, rhombic prisms. An ingredi-

ent in many of the oil sprays. An intestinal antiseptic, formerly employed in the treatment of typhoid fever, in doses of from 0.032 to 0.13 gm. (½ to 2 grains). In recent years it has proven to be a very valuable remedy in the treatment of hookworm disease, in which it is given in doses of 3 to 4 gm. (45 to 60 grains) after the patient has been prepared for its administration.

Thymolis Iodidum (thymol iodid, aristol). Chemically it is dithymol diiodid, and is prepared by adding thymol dissolved in sodium hydroxid solution to an aqueous solution of iodin and potassium iodid. A bright chocolate-colored or reddish-yellow precipitate is produced, which, when washed, collected, and dried, is thymol iodid. Used in surgery as a substitute for iodoform and as an external application to ulcers and skin diseases, either in the form of the dry powder or ointment.

Zinci Oxidum (zinc oxid, flowers of zinc, zinc white). A very fine white or yellowish-white powder, free from gritty particles. Made by treating native zinc carbonate with coal, in a special furnace, and collecting the zinc oxid formed in a chamber lined with muslin bags. Used externally as an astringent and exsiccant in the form of the dry powder or ointment. Internally as an astringent and antispasmodic. Dose, 0.065 to 0.33 gm. (1 to 5 grains).

Zinci Sulphas (zinc sulphate, white vitriol). Small colorless crystals, closely resembling magnesium sulphate. Made by treating metallic zinc with sulphuric acid, purifying, and crystallizing. Used as an emetic and an astringent internally, and as an astringent in the treatment of gonorrhea locally, in solution. Dose as an emetic, 0.65 to 1.3 gm. (10 to 20 grains).

Zingiberis Fluidextractum (fluidextract of ginger). Used to prepare the tincture of ginger by diluting 20 mils with sufficient alcohol to measure 100 mils. Stimulant, carminative, anodyne, and rubefacient. Dose, 0.33 to 1.3 mil (5 to 20 minims). The tincture is a better preparation to administer, as the fluidextract must be largely diluted because of its great pungency.

CHAPTER 11.

CHEMISTRY.

A knowledge of chemistry is important to everybody, chemical facts and principles being involved to some extent in every science and branch of industry. The hospital corpsmen are daily brought into contact with such subjects as hygiene and sanitation, fumigation and disinfection, aseptic surgery, dietetics, urine and water analysis, etc., and these are all, primarily, problems of chemistry.

The study of chemistry is advantageous in other ways, as it increases the student's power of observation, enabling him to draw correct conclusions from what he sees, and to test, experimentally, the truth of every statement.

The scope of this book is so limited that only the most important fundamental principles of the subject may be covered, and these principles explained as briefly and concisely as the subject matter will permit.

What is chemistry? Chemistry is the science of the properties of the elements, of the compounds formed by their union, and the laws which regulate the combination of these elements and to which their compounds are subject in their mutual action.

How is chemistry divided?

- CHEMISTRY...
  - Analytical chem.... The art of determining the composition of substances.
  - Descriptive chem... Deals with the chemical and physical characteristics of substances.
    - 1. Inorganic.. Deals with all substances except the carbon compounds.
    - 2. Organic.... Deals with carbon compounds.
  - General chem......
    - Theoretical.... Comprises the laws of the composition and chemical behavior of compounds.
    - Physical...... Treats of the physical properties of compounds and of the physical phenomena accompanying the transformations of substances.
  - Applied chem......
    - Biological.
    - Agricultural.
    - Industrial.

In what way is chemistry related to physics? Both chemistry and physics deal with the changes which take place in matter, the science of physics embracing such changes as do not affect the identity of matter, the phenomena of heat, light, gravitation, electricity, force, energy, motion, and weight all coming within the province of physics, while chemistry deals with the changes in which matter undergoes decomposition, losing its original identity and new compounds being formed.

What are chemical changes? Any change which involves the molecule of a substance in which the molecule loses its individual properties and a new molecule is formed which has new distinct properties and characteristics. The substance loses its original identity.

What may be given as a characteristic chemical change? A piece of iron when exposed to moist air soon becomes covered with a reddish-brown powder, and if the action is permitted to continue for a long period of time the iron will entirely disappear, the resulting brown powder having lost all the characteristics and properties of iron.

What may be stated as a characteristic physical change? The vaporization of water into steam. The vapor may be condensed and water in its original state obtained, proving that the change which took place was merely one of appearance, the original substance having undergone no decomposition.

What is matter? Matter is that which occupies space, has weight, and is apprehended by aid of our senses.

What are the principal fundamental properties of matter? Extension, divisibility, gravitation, porosity, indestructibility.

What is extension? Extension is the property, common to all matter, by which it occupies space.

What is divisibility? The common property of matter which admits of its being subdivided into smaller particles.

What is gravitation? The common property of matter by which its particles attract other particles. Masses exert this same attraction for each other, and the degree of attraction exerted is directly proportional to the size of the masses and

inversely proportional to the squares of their distance apart. This attraction between masses is called gravitation,

What is porosity? Porosity is the common property of matter to have spaces between the particles composing it. This varies in degree, but is extremely difficult to determine in the very dense substances. Some solids are very porous—charcoal, for instance—while others are so dense that great pressure would be required to force gas through them. But that this may be done has been proven in many instances where gas has been confined in metallic drums under great pressure for a long period of time.

What is indestructibility? The common property of matter, no particle of which may be destroyed. Chemical and physical changes are taking place constantly, but the elements composing matter of any kind are never lost. The effects of various chemical reactions result in the apparent loss of some of the gases formed, but it can easily be proven by analysis that they are present in the air, and, if desired, they may be recovered. When we see steam (water vapor) escaping into the air, where it is soon dissipated, we might readily believe that it was lost because of its disappearance, but that this is not true may be proven by allowing steam to escape into a closed room, where the vapor will be condensed and water may be obtained.

What other properties may matter, in its different states, assume? Solids have the following properties in addition to the above: Cohesion, hardness, brittleness, tenacity, malleability, ductility.

What is cohesion? The property by which the particles of a solid are so attracted by each other that the body has a self-subsistent figure and retains its shape.

What is hardness? That property by virtue of which some solids resist attempts to force a passage through their particles.

What is brittleness? That property of solids which causes them to be easily broken or fractured when external force is applied to them.

What is tenacity? That property of solids in virtue of which they resist attempts to pull their particles asunder.

What is malleability? That property of solids which permits of their being hammered or rolled into sheets.

What is ductility? That property of solids (metals in particular) which permits of their being drawn into fine wire.

What is force? The cause tending to produce, change, or arrest motion. It is a manifestation of energy.

What is energy? A universal property of matter, it is its capacity for doing work, and is measured by the work it can do. Energy may be manifested in many different forms, as motion of masses, heat, light, electricity, and chemical changes. Energy may be potential (stored up) or kinetic (actual).

How do liquids differ from solids as regards the physical properties mentioned above? Liquids have the property of cohesion in a much less energetic form, the repellant and attractive forces exerted by the particles composing a liquid being almost equally balanced. That cohesion is not entirely suspended may be proven by the formation of drops when a liquid is poured, these drops consisting of large numbers of molecules which are attracted to each other by the force known as cohesion.

In what forms does matter exist? Matter is known to exist in four forms or states of aggregation. These forms or states are known as solids, liquids, gases, and radiants, the last named being but lately discovered, and the theory of this as a fourth state or form of matter only recently propounded.

What is a solid? A solid is a mass of matter having definite shape and size of its own, force being required to overcome the cohesion of the molecules composing it; that is, the particles composing a solid are so firmly held together that a definite shape is assumed, and force of more or less degree is required to alter this shape.

What is a liquid? A liquid is a body in which the molecules move freely over one another. The attractive force and repellant force exerted by the molecules being equally balanced, the body assumes the shape of the container, having no self-subsistent figure. In other words, that cohesion of particles which is so marked in solids is much less pronounced in liquids, and

as a result the particles composing the liquid have free motion over one another, with the result that they have no definite shape of their own, but assume the shape of the container in which they are placed.

What is a gas? A gas is a body in which the repellant force exerted by the molecules is greater than the attractive force, and the molecules tend to separate, pressure being required to overcome this tendency. In other words, there is no attraction of the particles in gases, and as a result they tend to spread in all directions, and therefore must be confined in some vessel. It should be appreciated that varying quantities of a gas may be confined in this vessel, but the more we admit the more we add to the pressure, density, and elastic force.

What is a radiant? Uranium and thorium minerals give out rays or emanations which cause certain phosphorescent substances to become illuminated, act upon photographic plates which are wrapped in black paper, and also cause air through which the rays pass to become a good conductor of electricity. Prof. and Mme. Curie discovered that these emanations were given off by an element which they named radium, and they later discovered another element having similar properties which they named polonium. Debierne in the same year (1899) isolated another element, which he named actinium. These elements are of interest for the reason that the rays or emanations have been used to some extent in the treatment of cancers, etc.

How may all matter be subdivided? Matter may be subdivided into elementary and compound.

What is meant by elementary matter? All matter which consists of atoms and molecules of but one element.

What is compound matter? Compound matter is composed of molecules the atoms of which are unlike.

What methods are used for determining the composition of any substance? Analysis and synthesis.

What is analysis? Analysis is the separation of the component parts of any substance and the identification of the elements composing the same.

What is synthesis? Synthesis is the building up of a compound from its component parts by union of several distinct elements or radicals by chemical force.

What is an element? An element is the simplest form of matter, and can not be decomposed or further subdivided by any means known to science.

What is a compound? A compound is a substance the elements or component parts of which may be separated and its composite nature proven.

What is a molecule? A molecule is the smallest particle of matter into which a substance can be divided without losing its identity or the smallest particle of matter which can exist in a free state.

What is an atom? An atom is the smallest particle of matter which can enter into combination, or combine to form a molecule. The atom is incapable of existing in a free state, and when liberated by chemical force or action will immediately combine with other atoms to form molecules. Atoms are of necessity elemental in character.

What is meant by the term "molecular weight"? Molecular weight is the sum total of the weights of the atoms composing a molecule of a substance. For example, H_2O represents the molecule of water vapor; the weight of the molecule is equal to the sum of the combined atoms (hydrogen 2, plus oxygen 15.88, the total molecular weight being 17.88), and represents the weight of the molecule of water vapor as compared to an equal volume of hydrogen gas at like temperature and pressure.

What is atomic weight? Atomic weight is the relative weight of an atom of any element as compared with hydrogen, which is taken as the standard.

What is a symbol? A symbol is an accepted abbreviation of the name assigned an element, which is used for the purpose of simplifying the process of calculation in chemical arithmetic. Usually the first or first two letters of the Latin or Greek name of the element are used as the symbol, and this abbreviation represents not only the element but one atom of the element.

How many elements are at present known? About 80 have been isolated and definitely proven as elements.

How many elements are considered of sufficient importance as to require extended study? About 40, or one-half the total number known.

Name the more important elements, giving their symbols, valence, and atomic weights.

Name.	Symbol.	Valence.	Atomic weight.
Oxygen	O	2	15.88
Hydrogen	H	1	1.00
Nitrogen	N	3 and 5	13.93
Chlorin	Cl	1, 3, 5, and 7	35.18
Sulphur	S	2, 4, and 6	31.83
Carbon	C	4	11.91
Iodin	I	1, 3, 5, and 7	125.90
Phosphorus	P	3 and 5	30.77
Bromin	Br	1, 3, 5, and 7	79.36
Boron	B	3	10.90
Potassium (kalium)	K	1	38.86
Sodium (natrium)	Na	1	22.88
Lithium	Li	1	6.98
Barium	Ba	2	136.40
Strontium	Sr	2	86.94
Calcium	Ca	2	39.80
Magnesium	Mg	2	24.18
Zinc	Zn	2	64.90
Manganese	Mn	2, 4, 6, and 8	54.60
Cobalt	Co	2	58.56
Nickel	Ni	2	58.30
Aluminum	Al	3	26.90
Iron (ferrum)	Fe	(Ous 2; ic 3)	55.90
Chromium	Cr	2 and 4	51.70
Arsenic	As	3 and 5	74.40
Antimony (stibium)	Sb	3 and 5	119.30
Tin (stannum)	Sn	(Ous 2; ic 3)	118.10
Gold (aurum)	Au	3	195.70
Platinum	Pt	2 and 4	193.30
Copper (cuprum)	Cu	(Ous 1; ic 2)	63.10
Mercury (hydrargyrum)	Hg	(Ous 1; ic 2)	198.50
Lead (plumbum)	Pb	2	205.35
Bismuth	Bi	3	206.90
Silver (argentum)	Ag	1	107.12
Cadmium	Cd	2	111.60
Cerium	Ce	3	139.20
Fluorin	F	1	18.90
Silicon	Si	4	28.20
Radium	Ra	(Unknown)	223.00
Uranium	U	(Unknown)	236.70

What radical is considered with the elements in the study of chemistry, and why? Ammonium, NH_4, valence 1, molecular weight 17.93. This compound radical acts in forming salts very much like one atom of an alkali metal. It is incapable of existing in a free state, but the numerous salts are of considerable importance both in medicine and the arts.

How are the elements classified? One of the principal methods of classification groups the elements under either one of two heads, metallic or nonmetallic elements.

Name the principal metallic elements. Potassium, sodium, lithium, barium, strontium, calcium, magnesium, zinc, manganese, cobalt, nickel, aluminum, iron, chromium, arsenic, antimony, tin, gold, platinum, copper, mercury, lead, bismuth, silver, cadmium, cerium, radium, and uranium.

Name the principal nonmetallic elements, or metalloids. Oxygen, hydrogen, nitrogen, chlorin, sulphur, carbon, iodin, phosphorus, bromin, boron, fluorin, and silicon.

What cause enables or even forces the various elements to unite to form compound bodies? Chemical affinity or chemical force and bodies exerting this influence over one another are said to have an affinity for each other. We say oxygen has a chemical affinity for almost all other elements, both metals and nonmetals, with nearly all of which it combines directly to form oxids.

The more important elements with which oxygen does not combine directly are chlorin, bromin, iodin, fluorin, gold, silver, and platinum; the first four are called halogens, the term meaning "producers of salt"; the last three are called the noble metals, on account of their retaining their physical characteristics, especially the metallic luster, when exposed to moist air or oxygen, and readily giving up the oxygen present when their oxids are exposed to heat.

Chemical affinity or chemical force differs from the natural forces studied under physics, known as cohesion, adhesion, and gravitation, and may best be explained by describing the effect of each of these forces on one element, using sulphur for an example, in the form of brimstone. We can reduce a piece of

brimstone to a fine powder, thus overcoming cohesion by mechanical means, or volatilize it by heat, overcoming cohesion by the aid of heat. If we dip it into water, it becomes moist, in consequence of surface action or adhesion. If we throw it into the air, it will fall back to the earth in consequence of gravitation, but it still remains sulphur. Yet when it burns it combines with the oxygen of the air and is no longer recognizable as sulphur, but the disagreeably smelling gas SO_2 (a new compound) is formed. To overcome this chemical force or chemical affinity of elements in a compound chemical decomposition must occur, and may be brought about by aid of heat, as in reduction of the iron ores (oxids and sulphids) to the metallic state, by electricity (positive or metallic elements being attracted to the negative pole), or by light, as in photography.

What are reagents? Reagents are substances which will cause chemical reactions.

What is an acid? An acid is a compound of hydrogen with an electronegative element or group of elements in which the hydrogen is replaceable by a metal or base to form a salt. It changes the color of many organic substances (blue litmus to red), and has, when soluble in water, a sour taste. Example: Chlorin is an electronegative element, and when combined with hydrogen forms hydrochloric acid (HCl). This H may be replaced by sodium to form sodium chlorid (NaCl).

Name the official mineral acids.

Acidum Boricum, H_3BO_3.

Acidum Hydriodicum Dilutum (10 per cent by weight of absolute HI).

Acidum Hydrobromicum Dilutum (10 per cent by weight of absolute HBr).

Acidum Hydrochloricum (31.9 per cent by weight of absolute HCl).

Acidum Hydrochloricum Dilutum (10 per cent by weight of absolute HCl).

Acidum Hydrocyanicum Dilutum (2 per cent by weight of absolute HCN).

Acidum Hypophosphorosum (30 per cent by weight of absolute H_3PO_2).

Acidum Hypophosphorosum Dilutum (10 per cent by weight of absolute H_3PO_2).

Acidum Nitricum (68 per cent by weight of absolute HNO_3).

Acidum Nitrohydrochloricum, Acid. Nitrohydrochlor. Dil. These two acids are mixtures of nitric and hydrochloric acids, HNO_3 and HCl. See U. S. P.

Acidum Phosphoricum (85 per cent by weight of absolute H_3PO_4).

Acidum Phosphoricum Dilutum (10 per cent by weight of absolute H_3PO_4).

Acidum Sulphuricum (92.5 per cent by weight of absolute H_2SO_4).

Acidum Sulphuricum Aromaticum (20 per cent by weight of absolute H_2SO_4).

Acidum Sulphuricum Dilutum (10 per cent by weight of absolute H_2SO_4).

What is a base? A base or basic substance has properties chemically opposite to those of the acids. They are compounds of electropositive elements with oxygen, or more generally with oxygen and hydrogen. When acted upon by acids they form salts. They restore the color of organic substances which have been acted upon by acids (red litmus paper to blue), and when soluble in water they have an alkaline taste. Sodium oxid (Na_2O), calcium oxid (CaO), are examples of bases containing an electropositive element and oxygen alone. Potassium hydroxid (KOH) and ammonium hydroxid (NH_4OH) may be given as examples of bases composed of an electropositive element and an electropositive radical, respectively, combined with oxygen and hydrogen. When a base acts upon an acid its properties, as well as the properties of the acid, are neutralized.

What are neutral substances? All substances having neither acid nor basic properties are termed "neutral." Water is the most abundant neutral compound.

What is a salt? Salts are acids in which the hydrogen has been replaced by a metal, or by a basic radical. Salts may be

obtained by the action of an acid on a metal (for example, sulphuric acid on zinc: $Zn+H_2SO_4=ZnSO_4+H_2$, zinc sulphate being the salt formed and hydrogen gas being evolved or given off); by the action of an acid on an oxid or hydroxid of a metal (for example, $ZnO+H_2SO_4=ZnSO_4+H_2O$); by the action of an acid on a salt of a volatile acid (for example, $MgCO_3+H_2SO_4=MgSO_4+H_2O+CO_2$; the salt of a volatile acid in this instance was magnesium carbonate, and the salt formed was magnesium sulphate, the by-products of the reaction being water (H_2O), and carbon dioxid (a gas) (CO_2)); or by the action of one salt upon another salt, when one of the products is insoluble or nearly so (for example, $MgSO_4+Na_2CO_3=MgCO_3+Na_2SO_4$, magnesium sulphate and sodium carbonate under proper conditions form magnesium carbonate and sodium sulphate; magnesium carbonate is nearly insoluble in water, while sodium sulphate is quite freely soluble). Nearly all the carbonates and phosphates are obtained by this method, which is called the precipitation method.

What is a normal salt? Salts formed by the replacement of all the replaceable hydrogen atoms in an acid. (They may have either a neutral, alkaline, or acid reaction to litmus.) Examples: Potassium carbonate (K_2CO_3) has a strongly alkaline reaction in solution. Potassium iodid (KI) should be neutral or but very slightly alkaline. Sodium nitrate ($NaNO_3$) is neutral to litmus paper. Lead nitrate ($Pb(NO_3)_2$) has an acid reaction on litmus paper.

What is an acid salt? Salts formed by the replacement of only a part of the replaceable hydrogen atoms of an acid. Sodium bicarbonate ($NaHCO_3$) and potassium bisulphate ($KHSO_4$) may be given as examples.

What is a basic salt? A basic salt is a compound containing a higher proportion of the base than is necessary for the formation of a normal salt. They may be defined as bases in which only a part of the replaceable hydrogen atoms have been replaced by acid radicals. As examples: Basic lead nitrate ($Pb(NO_3)_2.Pb(OH)_2$), basic mercuric sulphate ($HgSO_4.(HgO)_2$). To explain the reaction and formation of basic salts graphically,

if we take the first-named salt $2Pb(OH)_2+2HNO_3=Pb(NO_3)_2+Pb(OH)_2+H_2O$, it will be noted that water is a product of the reaction, and the two lead compounds if separable from the solution free from one another would be normal salts, but when evaporated to a pellicle the two crystallize together, forming the salt known as basic lead nitrate, having the formula $Pb(NO_3)_2.Pb(OH)_2$. These salts are known as subsalts, as subnitrate of lead, subnitrate of bismuth, subsulphate of mercury, etc. They are also often called oxysalts. The formation of these salts is due to the fact that insufficient acid is used to completely neutralize the base, either oxid or hydroxid.

What are double salts? Salts of acids having two or more replaceable hydrogen atoms which are replaced by two different elements. $KNaSO_4$ and $NaNH_4SO_4$ may be given as examples. Sulphuric acid (H_2SO_4) has two replaceable hydrogen atoms, one of which has been replaced by sodium and the other by potassium in the first salt mentioned, sodium-potassium sulphate; and in the second instance one atom of hydrogen was replaced by sodium, the other by ammonium.

What is a chemical formula? A chemical formula consists of two or more symbols of elements, written side by side, which express the result of chemical affinity between the elements represented. If a flame is introduced into a container in which the two elements hydrogen and oxygen have been collected, an explosion results, and water vapor is formed, the two gases H and O combining in the proportion of 2 to 1, respectively, and the formula representing this combination is H_2O, which denotes that two atoms of hydrogen and one of oxygen have combined to form one molecule of water. As O is 15.88 times as heavy as H, the oxygen in a molecule of water weighs 7.94 times as much as the hydrogen. So the chemical formula represents not only the kind of atoms making up the molecule, but the ratio of each and a definite weight of the substance formed in grams. This weight is the sum of the atomic weights of the atoms represented in the formula taken as grams. As in the above formula, for instance, H has an atomic weight of 1, and there are two atoms; O has an atomic weight of 15.88, which

added to 2 makes a total weight of 17.88 grams; the total weight here given is called the formula weight.

What is an empirical formula? The simplest expression by symbols of the chemical composition of any substance. NH_3 is the empirical formula for the radical ammonia. The empirical is also called the molecular formula, as it only shows the kind and number of atoms present in the molecule.

What is a graphic or structural formula? The graphic or structural formula is intended to represent the theories formed in regard to the arrangement of the atoms composing a molecule of any substance. The graphic formula for ammonia would be represented thus:

$$\begin{array}{ccccc} H & — & N & — & H \\ & & | & & \\ & & H & & \end{array}$$

showing that the trivalent element nitrogen had combined in the proper proportions with the monovalent element hydrogen to form a saturated compound molecule.

What is valency? When one element replaces another element in a compound the quantities of the two elements are said to be equivalent to each other, and this replacement always takes place in definite proportions. The atom of hydrogen, being the lightest known substance, was taken as a standard for the determination of valency of other elements, valence being defined as the relative combining power of the different elements as compared to hydrogen, which is taken as the standard. The valence of an element is obtained by experimentally combining it with hydrogen or replacing the hydrogen of an acid by a definite quantity of the element. All elements which combine with H in the proportion of one atom to one atom are univalent—for example, chlorin, iodin, bromin, and fluorin—and all atoms of elements which combine with these in the same proportion are also univalent, as sodium, potassium, silver, etc.

Bivalent elements are those which combine with hydrogen or other univalent elements in the proportion of one atom to two atoms. For example, oxygen, sulphur, selenium, etc.

Trivalent elements are those which combine with hydrogen or other univalent elements in the proportion of one atom to three atoms. For example, nitrogen, boron, aluminum, gold, etc.

Quadrivalent elements are those which combine with hydrogen or other univalent elements in the proportion of one atom to four atoms. For example, carbon, silicon, etc.

When elements combine in the proportion of one atom to five they are called quinquivalent, and in the proportion of one to six they are said to be sexivalent.

The elementary atoms are often named according to their valence, as follows: Monads, diads, triads, tetrads, pentads, hexads, and heptads. Thus we say that oxygen is a diad, while hydrogen is a monad.

To indicate their valence, dots or small Roman numerals are placed above and to the right of the symbol, as follows: $O^{\cdot\cdot}$, or O'', H' or $H^{\cdot}$, C'''' or C^{iv}.

What are the principal laws of chemical compositions?

(1) The law of definite proportions states that a definite compound always contains the same elements in the same proportion. This law is also called the law of the constancy of composition, and was the first law recognized in chemical science.

(2) The law of multiple proportions states that if two elements A and B are capable of uniting in several proportions, the quantities of B which combine with a fixed quantity of A bear a simple ratio to each other. Thus we have two oxids of sulphur known as sulphur dioxid (SO_2), a gas, and sulphur trioxid (SO_3), a solid. In these the quantities of oxygen united with a fixed weight of sulphur are in the ratio of $1:1\frac{1}{2}$ or $2:3$. Another example is well demonstrated in the iron and sulphur compounds known as ferrous sulphid (FeS) and iron pyrites (FeS_2), wherein the quantity of iron which combines with sulphur is fixed, the ratio of sulphur combining with this fixed

weight of iron being as 1:2. It should be remembered that when the two elements are brought together under natural conditions no chemical change takes place, but if we place the proper quantities of each element, in a state of fine subdivision, in a retort and apply heat they will combine to form ferrous sulphid. Iron pyrites is one of the chief compounds of iron found in nature.

(3) The law of Boyle, sometimes called the law of Mariotte, is stated thus: The volume of a gas is inversely as the pressure; the density and elastic force are inversely as the volume and directly as the pressure.

(4) The law of Avogadro is stated thus: All gases or vapors, without exception, contain in the same volume, under like conditions of temperature and pressure, the same number of molecules.

(5) The law of gravitation, known as Newton's law, is stated thus: All bodies attract each other with a force directly proportional to their masses and inversely proportional to the squares of their distance apart. Gravitation, cohesion, and adhesion are physical phenomena; in gravitation we have an attractive force exerted between masses of elements or compounds; in adhesion molecules or particles of a solid attract the molecules or particles of a liquid; and in cohesion the molecules or particles of a substance attract each other.

What are chemical equations? The starting point in all chemical calculations in which the quantities of substances entering into chemical combination or causing chemical action, or the quantities of the product formed, are concerned. For example, let us make hydrochloric acid (HCl). Our most common chlorid is table salt or sodium chlorid, the formula for which is $NaCl$, and by acting upon $NaCl$ with H_2SO_4 we obtain HCl and $NaHSO_4$, or, if proper amounts are used, the result will be stated by equation thus: $2(NaCl)+H_2SO_4=NaSO_4+2(HCl)$. It is necessary for us to know the atomic weights of the elements and be able to calculate the molecular weights of the compounds formed, so that we may know how much of each compound must be used to form a given quantity of product. If

we desire 100 pounds of absolute HCl, how much sodium chlorid must we decompose? Sodium (Na) has an atomic weight of 22.88; chlorin has an atomic weight of 35.18; the molecular weight is the sum of these two figures, or 58.06. It is necessary to use two molecules of the sodium chlorid to replace the two hydrogen atoms in the sulphuric acid, as sodium is a monovalent element; therefore to complete the equation the molecular weight 58.06 must be multiplied by 2, which gives a total weight of 116.12. The molecular weight of hydrochloric acid (H=1, Cl=35.18) is 36.18, and two molecules are formed, so this weight is also multiplied by 2, which gives a total weight of product 72.36; the problem may then be figured in proportion, thus: 72.36 : 116.12 : : 100 : X (X in this case equals 160.47). Therefore, to manufacture 100 pounds of absolute HCl would require 160.47 pounds of sodium chlorid.

If we wished to know how much sodium sulphate would be formed in the above procedure, it would be necessary for us to know the molecular weight of sodium sulphate. Na=22.88, S=31.83, O=15.88; in the molecule we have 2 Na atoms, 1 S atom, and 4 O atoms:

22.88 multiplied by 2=45.76 represents the Na_2
31.83 (one atom only)=31.83 represents the S
15.88 multiplied by 4=63.52 represents the O_4

141.11

Then if 116.12 pounds of sodium chlorid will form 141.11 pounds of sodium sulphate, 160.47 pounds of sodium chlorid will form how much? By proportion 116.12 : 141.11 : : 160.47 : X (X in this case is about 195 pounds). The same result may be obtained by taking the molecular weights of the products as a base for the proportion; thus, 72.36 : 141.11 : : 100 : X. In all equations it is essential that we know the atomic weight and valence of the elements taking part in the reaction.

What is a radical? A radical (sometimes termed residue, or compound radical) is an unsaturated group of atoms known to enter as a whole into different combinations or compounds,

but having no separate existence. Example: There are two series of salts of bismuth, known as normal and subsalts, respectively. The normal salts are combinations of the metal bismuth with an acid radical (or residue), while the subsalts are formed from the radical bismuthyl (BiO), a compound molecule of bismuth and oxygen. The distinction is made evident by a glance at the formulas of the series of bismuth compounds:

Normal salts.	*Subsalts.*
Bismuth chlorid $BiCl_3$.	Bismuthyl chlorid $(BiO)Cl$.
Bismuth bromid $BiBr_3$.	Bismuthyl bromid $(BiO)Br$.
Bismuth iodid BiI_3.	Bismuthyl iodid $(BiO)I$.
Bismuth nitrate $Bi(NO_3)_3$.	Bismuthyl nitrate $(BiO)NO_3$.
Bismuth sulphate $Bi_2(SO_4)_3$.	Bismuthyl sulphate $(BiO)_2SO_4$.

It will be noted that the radical (bismuthyl (BiO)) has a valence of one, while the metal, bismuth, has a valence of three. The bismuthyl salts are better known under the name of bismuth subchlorid, subbromid, subnitrate, etc.

Name a few of the more important radicals.

Hydroxyl (OH), found in all hydroxids (or hydrates).

Nitric (NO_3), found in all nitrates.

Sulphuric (SO_4), found in all sulphates.

Sulphurous (SO_3), found in all sulphites.

Carboxyl (COOH), found in all organic acids.

Carbonic (CO_3), found in all carbonates.

Carbonyl (CO), found in all ketones.

Aldehyd (COH), found in all aldehyds.

Chlorous (ClO_2), found in all chlorites.

Chloric (ClO_3), found in all chlorates.

Phosphoric (PO_4), found in all phosphates.

Ammonium (NH_4), found in all ammonium compounds.

Cyanogen (CN), found in all cyanids.

Boric (B_4O_7), found in all borates, except hydrogen borate (acidum boricum) (H_3BO_3), which when heated to 100 C. (212 F.) forms metaboric acid (HBO_2); when further heated to

160 C. is converted into tetraboric acid ($H_2B_4O_7$), from which the borates are derived. The radicals above mentioned are but a few of the many thousands known. A radical and an element may be combined to form a compound, or two radicals may be combined to form a compound, and in the case of a number of the organic compounds there are several radicals in combination.

How many kinds of chemical reactions are there? There are four kinds: (1) Direct combination, $H_2O+NH_3=NH_4OH$. (2) Direct decomposition, $CaCO_3$ when heated equals $CaO+CO_2$. (3) Substitution, $K+H_2O=KOH+H$. (4) Double decomposition, $MgSO_4+Na_2CO_3=MgCO_3+Na_2SO_4$.

In the above reactions the following compounds are formed: (1) Ammonium hydroxid, by saturating water (H_2O) with ammonia gas (NH_3). (2) Calcium oxid; carbon dioxid being evolved or given off. (3) Potassium hydroxid; hydrogen being evolved. (4) Magnesium carbonate; sodium sulphate remaining in solution.

How should the study of chemistry of the elements be carried out, in detail? After thoroughly covering the fundamental principles of chemistry, the study of the individual elements should be taken up in accordance with the plan outlined in the textbooks on chemistry. The student should know the following concerning each of the more important elements, at least:

Occurrence in nature (state of aggregation or form, whether solid, liquid, gaseous, or a radiant).

Source (where found, how obtained) or preparation.

Appearance (physical properties).

Chemical properties.

Atomic weight.

Chemical symbol.

Valency.

Relation to animal and vegetable life.

As an example, the element oxygen will be briefly discussed.

Oxygen is the most abundant element known, one-fifth of the air surrounding the earth being O. Water contains eight-ninths of its weight of O, most of the rocks and mineral con-

stituents of the earth contain O, in some cases to the extent of 50 per cent of their weight, and it is present in all animal and vegetable matter.

The oxids of the noble metals (gold, silver, mercury, and platinum) are easily decomposed by heat into the metal and O. This is more easily produced, however, by the decomposition of potassium chlorate ($KClO_3$) into potassium chlorid (KCl) and oxygen by the application of heat.

Oxygen is a colorless, odorless, tasteless gas, slightly heavier than air, which can be condensed by pressure (50 atmospheres) and a low temperature (—118 C.) to a transparent, pale bluish liquid (for practical and medical purposes is usually condensed by a pressure of about 225 pounds to about one-fifteenth of its volume). O is but sparingly soluble in water (3 v. in 100).

The principal feature of O is its great affinity for other elements, both metals and nonmetals; it combines with all but a few of them directly. This act of combination is called oxidation, and the products formed are called oxids. Many compounds contain oxygen so loosely held in combination that they give up the O to other substances with which they come in contact; such compounds are called oxidizing agents—for instance, nitric acid, potassium permanganate, potassium chlorate, etc. O is a supporter of combustion; substances which burn in air will burn much more rapidly in pure O. The process of oxidation evolving no light is called slow combustion.

The atomic weight of O is 15.88, its chemical symbol O, its valence 2.

Living vegetable matters are constantly generating and evolving O, and all animals require oxygen to sustain life.

Ozone is an allotropic modification of O, which is formed by the passage through the atmosphere of nonluminous electric discharges, or when phosphorus, partially covered with water, is exposed to air. It has a peculiar odor and is much stronger in its oxidizing effects than O.

The scope of this book prohibits a thorough presentation of the subject of organic chemistry on account of the limited space and the enormous number of known organic compounds. Those

who may desire to study the subject should procure standard textbooks on that branch of the science of chemistry. The importance of this subject may be readily appreciated by a study of the following list of the organic compounds which are on the Supply Table of the Medical Department of the Navy.

Acetphenetidinum (phenacetin) $C_{10}H_{13}O_2$.

Acetylsalicylic acid (aspirin) $C_9H_8O_4$.

Acidum aceticum glaciale CH_3COOH, 99 per cent by weight of absolute acid.

Acidum benzoicum C_6H_5COOH.

Acidum citricum $C_3H_4.OH.(COOH)_3+H_2O$.

Acidum salicylicum $C_6H_4OH.COOH$.

Acidum tannicum $C_{13}H_9O_7COOH$.

Acidum tartaricum $C_2H_2(OH)_2(COOH)_2$.

Aether, 96 per cent by weight of ethyl oxid $(C_2H_5)_2O$.

Aethylis chloridum C_2H_5Cl.

Amylis nitris $C_5H_{11}NO_2$.

Antipyrina $C_{11}H_{12}N_2O$.

Camphora $C_{10}H_{16}O$.

Chloralum hydratum $C_2HCl_3O+H_2O$.

Chloroformum $CHCl_3$.

Cocainæ hydrochloridum $C_{17}H_{21}NO_4.HCl$.

Codeinæ sulphas $(C_{18}H_{21}NO_3)_2.H_2SO_4$.

Cresoti carbonas,
Creosotum. } From creosotum, a mixture of phenol and phenol derivatives, chiefly guaiacol and creosol.

Eucainæ hydrochloridum $C_{15}H_{21}NO_2.HCl$.

Eucalyptol $C_{10}H_{18}O$.

Glycerin $C_3H_5(OH)_3$.

Guaiacol $C_7H_8O_2$.

Hexamethylenamina $C_6H_{12}N_4$.

Homatropinæ hydrobromidum $C_{16}H_{21}NO_3.HBr$.

Iodoformum CHI_3.

Menthol $C_{10}H_{20}O$.

Methylis salicylas $C_6H_4OH.COOCH_3$.

Morphinæ diacetyl hydrochloridum $(C_{17}H_{17}NO)$ $(C_2H_3O_2)_2.HCl$.

Morphinæ sulphas $(C_{17}H_{19}NO_3)_2.H_2SO_4+5H_2O$.

Petrolatum (a mixture of hydrocarbons chiefly of the methane series).

Petrolatum liquidum (obtained from petroleum by distillation).

Phenylis salicylas $C_{13}H_{10}O_3$.

Physostigminæ sulphas $(C_{15}H_{21}N_3O_2)_2.H_2SO_4$.

Quininæ chlorhydrosulphas $(C_{20}H_{24}N_2O_2)_2.H_2SO_4.2HCl+3H_2O$.

Quininæ sulphas $(C_{20}H_{24}N_2O_2)_2.H_2SO_4+7H_2O$.

Resorcinol $C_6H_6O_2$.

Sulphonethylmethanum (trional) $C_8H_{18}S_2O_4$.

Thymol $C_{10}H_{14}O$.

Thymolis iodidum $(C_{10}H_{13}O)_2.I_2$.

Acidum oxalicum $C_2H_2O_4+2H_2O$.

Cresol C_7H_7OH.

Liquor formaldehydi H.COH (an aqueous solution 37 per cent by weight of absolute H.COH).

Paraformaldehydum $C_3H_6O_3$.

Phenol C_6H_6O.

Alcohol C_2H_5OH.

CHAPTER 12.

TOXICOLOGY.

What is toxicology? Toxicology is that branch of medical science which treats of the nature, effects, detection, properties, and antidotes of poisons.

What is a poison? A poison is any substance which when absorbed into the body fluids is capable of producing death or serious illness.

Which substances are not classed as poisons, yet are capable of producing death or imperiling life? Any substance that produces death by acting in a mechanical way is not considered as a poison, e. g., a cherry stone may become arrested in the vermiform appendix and may produce death, but it is not considered as a poison.

How are poisons administered? In any of the ways that drugs may be administered.

What effects may poisons have? Poisons may have a local and remote effect.

What is meant by local effect? By local effect is meant the direct action on the part to which the poison is applied.

What are the signs of local effects of poisons? Corrosion and irritation of the part to which the poison is applied.

What is meant by remote effect? By remote effect is meant the action of the poison on some organ distant from the seat of application; there are some poisons, however, which have both a local and remote effect, e. g., cantharides has a local effect at the seat of application and a remote effect on the genito-urinary organs.

What agencies modify the action of poisons? Quantity, dose, abitual use, mental and bodily condition, age.

What diagnoses are applied to cases of poisoning? Poisoning acute and poisoning chronic.

What is meant by poisoning acute? By poisoning acute is meant the condition brought on by the individual taking one overdose of the poison.

What is meant by poisoning chronic? By poisoning chronic is meant the condition brought on by the individual taking repeated doses of a poison or as the result of the absorption of the poison over a long period of time.

Name some classes of people that are subject to chronic poisoning. Matchmakers, barometer makers, thermometer makers, painters, and wall paperers.

What is meant by a symptom? A symptom is a circumstance happening at the same time as the disease, serving to point out the nature, character, and seat of the malady.

What is the duty of an attendant in a case of poisoning? (1) To prolong the life of the individual, if possible. (2) To quickly get the bulk of the poison out of the stomach. (3) To antidote the remainder left in the stomach. (4) To eliminate from the system that portion of the poison that has been absorbed. (5) To treat the symptoms as they arise. (6) To take possession of all foods, medicines, vomitus, feces, urine, and anything that may be of value in determining whether the poison was taken accidentally or intentionally, or whether criminally administered.

How are poisons classified? The classification of poisons is difficult, but for convenience of study they are classified as *corrosives*, *irritants* (simple and specific), *neurotics*, and *gaseous poisons*.

What is a corrosive poison? A corrosive poison is any substance which by contact rapidly destroys or decomposes the bodily tissues; e. g., hydrochloric, nitric, and sulphuric acids in concentrated form.

What is a simple irritant? A simple irritant is an agent that does not directly destroy the tissues, but may set up an inflammation at the seat of application; e. g., potassium nitrate.

What is meant by a specific irritant? A specific irritant is an agent which produces a local inflammation and also has specific and well marked properties different in each case; e. g., arsenic, iodin, phosphorus.

What is meant by a neurotic? A neurotic is a poison which acts on the nervous system. The action of the neurotic is on the brain, spinal cord, and other parts of the general nervous system; e. g., nux vomica, belladonna, opium, alcohol.

Name the most important corrosives. Sulphuric, nitric, and hydrochloric acids (concentrated), oxalic acid, phenol, the strong alkalis, and the alkaline carbonates.

Name the most important simple irritants. Potassium nitrate, zinc chlorid, zinc sulphate, ferrous sulphate, silver nitrate, and a number of vegetable irritants which includes jalap, aloes, colocynth, elaterium, and croton oil.

Name the most important neurotics. Opium, prussic acid, ether, chloroform, aconite, nux vomica, belladonna, ethyl alcohol, and methyl alcohol.

Name the most important gaseous poisons. Hydrochloric-acid gas, sulphuric-acid gas, nitrous vapors, ammonia gas, carbonic-acid gas, bromin, and the vapors of the anesthetics.

What are the effects of the gaseous poisons? Some of the gases are irritants while others have a specific effect, apparently because they form chemical compounds with the hemoglobin of the blood and destroy its capability as a carrier of oxygen.

How are the effects of poisons combated? By the use of counteracting agents called antidotes.

What is an antidote? An antidote is any agent given to counteract the effects of a poison.

What are the characteristics of a good antidote? It should be capable of being taken in a large dose without any danger and should act quickly on the poison (this action should also deprive the poison of its deleterious properties).

How many kinds of antidotes are there. Two, viz, chemical and physiological.

What is a chemical antidote? A chemical antidote is an agent that combines directly with the poison and renders it inert

or harmless or produces a more insoluble compound and thus delays the absorption of the poison.

What is a physiological antidote? A physiological antidote is an agent that counteracts the effects of the poison on the system.

By what other means are the effects of poisons combated? By the use of emetics.

What is an emetic? An emetic is any agent used to produce vomiting.

How many kinds of emetics are there? There are two kinds of emetics, local and systemic.

What is the action of the local emetic? The local emetic acts by irritating the ends of the gastric, esophageal, and pharyngeal nerves.

What is the action of the systemic emetic? The systemic emetic acts on the vomiting center in the medulla, through the medium of the circulation.

Describe the act of vomiting. Vomiting is an evacuant act which consists of the compression of the stomach with the simultaneous contraction of the diaphragm and abdominal muscles, accompanied by a relaxation of the cardiac orifice of the stomach. If both acts occur at the same time, the result is vomiting; if these acts do not occur simultaneously, the condition known as retching follows.

Name some of the commonly used emetics. Powdered ipecac, 30 grains; ground mustard, 2½ drams; tartar emetic, ½ to 1 grain; zinc sulphate, 10 to 20 grains; copper sulphate, 5 to 7½ grains; fluidextract of ipecac, 15 to 30 min.; tepid water, large quantity; warm salt water, large quantity; alum, 60 grains to 8 fluidounces of water; use of index finger; apomorphin hydrochlorid (hypodermically), $\frac{1}{15}$ to $\frac{1}{8}$ grain.

What other method besides those mentioned is used for combating the action of poisons? The method of washing out the stomach with the stomach tube.

What is the general treatment for cases of suspected poisoning? (1) Treat the case as one of poisoning. (2) Give the readiest antidote, however imperfect it may be, and do not wait to find

a perfect one. (3) Get rid of the poison by the use of emetics or the stomach tube. (4) Stop the action of the poison by the administration of the chemical antidote. (5) Protect destroyed membranes by the use of mucilaginous drinks; this procedure applies especially to cases of corrosive poisoning. (6) Treat the symptoms as they arise, and give proper diet and careful nursing.

What are the symptoms of corrosive poisoning? Immediately there is an acid, caustic taste and burning pain in the mouth with severe burning pain in the esophagus and stomach (wherever the corrosive has touched); this is followed by retching and vomiting of the stomach contents mixed with dark-colored liquid, with shreds of mucous membrane from the mouth, esophagus, and stomach; the inside of the mouth is corroded, and the lips will present the characteristic stain if an acid has been used; there is great thirst, difficulty in swallowing, and impeded respiration; the abdomen is tender and distended with gas; there is high fever and an anxious countenance, which is expressive of great suffering.

To what poisons are the above symptoms especially referable? Nitric acid, sulphuric acid, hydrochloric acid, ammonia water, sodium hydroxid, and potassium hydroxid (all concentrated).

What result is feared after recovery from the immediate effects of a corrosive? Constriction of the esophagus, which may produce death by starvation.

Name two corrosives which in addition to their local action produce well-marked remote and specific effects. Phenol and bichlorid of mercury.

What is the treatment for cases of poisoning by the mineral acids? Do not use the stomach tube; if the patient can swallow, give dilute solutions of the alkalis until it may be inferred that the acid has been neutralized, then follow with oleaginous and mucilaginous fluids, such as olive oil, linseed tea, barley water, mucilage of acacia, milk, or gruel.

What is the treatment for cases of poisoning by the caustic alkalis? The same as for acids with the exception that to neutralize the alkali a dilute solution of an acid is used. *It*

must be remembered that dilute prussic acid (hydrocyanic acid) must not be used.

What are the symptoms of poisoning by oxalic acid? Burning pain in mouth, throat, and stomach, destruction of membrane by contact, intense thirst, difficulty in speaking and swallowing, and staining of the tissues and clothing.

For what common remedy is this acid sometimes mistaken? Magnesium sulphate (Epsom salt).

How does oxalic acid stain the clothing and tissues? Clothing dark brown to red; tissues white or brown.

What is the treatment of oxalic acid poisoning? Do not use the stomach tube; give chalk, limewater, or, if necessary, use the plaster off the walls and follow with mucilaginous drinks. *Do not use the alkalis of sodium and potassium for the neutralization of this acid.*

What are the symptoms of phenol poisoning? Taken in concentrated form this drug acts as a corrosive and causes whitening and shrinking of all membranes with which it comes in contact; the patient becomes speedily comatose on account of the profound action of the poison on the great nervous centers; at first there is a burning pain in the mouth, throat, and stomach, which, after a little while, subsides on account of the anesthetic influence of the drug; there is usually stertorous breathing and contracted pupils; death usually follows in a few hours. A curious phenomenon—dark green urine (carboluria)—is observed after the administration of this poison.

What is the treatment for cases of phenol poisoning? The first thing that is sought is the neutralization of the poison by the administration of magnesium or sodium sulphate; administer emetics and follow with stimulants, as ether, atropin, brandy, or coffee; give demulcent drinks; apply hot-water bags and warm blankets.

How does magnesium sulphate act as an antidote against phenol? By forming with the phenol the inert phenol sulphonate of magnesium and as the magnesium sulphate has a slightly purgative action its use is justified.

66071°—17——18

What substance was formerly considered antidotal to phenol? Alcohol; it is now limited in this respect to neutralizing the local action of phenol.

Why is alcohol not used as an antidote against phenol? Because it reduces the vitality of the patient and facilitates absorption of the drug.

What are the symptoms of poisoning by corrosive sublimate? This substance gives rise to all the symptoms of a corrosive in the severest form—burning pain in mouth, throat, and abdomen; metallic taste in mouth; face flushed; abdomen tender; vomiting; bloody stools; tongue and lips shriveled and white; sense of constriction in throat; quick, irregular pulse; cold extremities; suppressed urine; syncope; convulsions; and death. If the dose be sufficiently large, it may cause death on the scene; if not, death may occur in a few weeks on account of irritation of the kidneys, with resulting uremia. A bold face is characteristic in suicides.

What is the treatment of corrosive sublimate poisoning? First administer the chemical antidote, which is albumen (the white of one egg for each 4 grains of the poison taken); promote vomiting by the use of copious drafts of albumen water; then administer demulcent drinks, milk, or ice water.

What precaution should be taken in administering albumen? Too much should not be administered, as albuminate of mercury is resolvable in an excess of albumen.

How does albumen act as an antidote against bichlorid of mercury (corrosive sublimate)? By forming with it an inert albuminate of mercury.

What is the treatment of chronic mercurial poisoning? The administration of potassium iodid.

How does potassium iodid act in chronic cases of mercurial poisoning? This salt destroys the compounds formed by the union of the mercury with certain of the tissues and aids in its elimination by the kidneys.

In what class of people is mercurial tremor seen most frequently? Water gilders, looking-glass makers, barometer makers, and thermometer makers.

What are the symptoms produced by simple irritants? Nausea, vomiting, and purging (frequently the vomited matter and stools contain blood); pain and cramps in abdomen. In some cases there is inflammation of the urinary tract.

What are the symptoms of silver nitrate poisoning? Pain in the mouth, throat, and abdomen; vomiting of white, flaky matter, which blackens on exposure to light; convulsions and coma.

What is the treatment of silver nitrate poisoning? The free administration of sodium chlorid (table salt), emetics, and demulcent drinks.

Which specific irritants are most commmonly used in the Navy? Arsenic, iodin, and lead.

What are the symptoms of iodin poisoning? Acrid taste in mouth, pain and sense of great warmth in throat, intense thirst, vomiting and purging (vomitus contains traces of iodin), vertigo, cyanosis, swollen eyelids, convulsive movements, and collapse.

What is the treament of iodin poisoning? The free administration of starch or any starchy substance, the induction of vomiting, stimulants hypodermically, demulcent drinks, external heat, and careful nursing.

What are the symptoms of arsenic poisoning? Faintness and depression come on in about one-half hour; intense pain in the region of the stomach, tenderness of abdomen on slight pressure, nausea and vomiting increased by every act of swallowing; purging, bloody stools, cold clammy skin, feeble pulse.

What is the treatment of arsenic poisoning? Wash out stomach, give emetics, follow with a wineglassful of recently prepared ferric hydroxid with magnesium oxid; give demulcent drinks, opiates, and apply external heat.

How would you make an extemporaneous antidote for arsenic? Precipitate a solution of ferric chlorid with ammonia water, wash out the excess of ammonia with water, then give the precipitated ferric hydroxid in tablespoonful doses.

What is the best way to administer this precipitated ferric hydroxid? The best way to administer this preparation is in milk.

Describe briefly Marsh's test for arsenic. A flask of about 500 mils capacity is stoppered with a rubber stopper having two perforations in it. Into each of these perforations is inserted a glass tube, one being for the introduction of the acid and the other for the exit of the gas generated. The suspected substance and a few scrapings of metallic zinc are placed in the flask. On these a solution of hydrochloric acid is poured, the action of the acid causes a gas to generate and find its way out the long tube. The gas having reached the end of the long tube (which must be away from the bottle about 16 inches to prevent an explosion) is lighted and a porcelain dish held into the flame; a grayish metallic deposit indicates either arsenic or antimony.

How do you differentiate arsenic and antimony? A solution of chlorinated soda is used; the arsenic is soluble in it, while the antimony is not.

What are the symptoms of lead poisoning? A sense of constriction about the throat, cramps, stiffness of abdominal muscles, blue line around the gums, paralysis of upper limbs, dropped wrist, vomiting of white, flaky matter, and constipation.

Which of the artificers of the Navy are subject to lead poisoning? Painters.

What is the treatment of lead poisoning? The free administration of soluble sulphates, followed by milk and raw eggs, emetics, and the use of the stomach tube.

What are the symptoms produced by the irritant gases? The irritant gases produce irritation and corrosion of the respiratory tract with a resulting bronchitis (either mild or severe); they are also irritating to the eyes, mouth, stomach, and kidneys.

What is the treatment of poisoning by the irritant gases? Remove the patient from the source of the gas, give inhalations of ammonia, and begin artificial respiration at once. When free

respiration is established give magnesium oxid or the dilute alkalis.

What are the symptoms produced by poisonous doses of morphin? When a large dose of opium or morphin has been taken the symptoms usually manifest themselves in about one-half hour. They commence with giddiness, drowsiness, and stupor. Usually there is a period of exhilaration, followed by a period of depression. As the poisoning progresses there is slow stertorous breathing, cold, clammy skin, livid countenance, slow pulse, muscular relaxation, drowsiness, pupils contracted (pin point), total insensibility to external impressions, deep sleep from which, if the patient be aroused, there will be an irresistible predisposition to go back to sleep, and death.

How is death caused by morphin poisoning? By paralysis of the respiration.

Name some of the commonly used preparations of opium (from which morphin is derived) capable of producing the same symptoms. Tincture of opium (laudanum), camphorated tincture of opium (paregoric), compound tincture of opium (Squibb's mixture), compound morphin powder (Tully's powder), codein, heroin.

What is the treatment of morphin poisoning? First, the removal of the poison from the stomach by the use of the stomach tube or emetics. The stomach wash, if used, should contain 20 grains of potassium permanganate to the pint of water. After the stomach has been washed out with this solution a little (about 1 fluidounce) should be administered and left in the stomach. In the absence of potassium permanganate an emetic should be administered hypodermically (emetics by mouth are generally useless), and after evacuation of the stomach the use of tannic acid in some form is indicated. Cathartics and diuretics should be administered for the prevention of absorption. Strong coffee is very efficient in cases of this poisoning. Efforts should be made to keep the patient awake, but no violence should be used. For a physiological antidote one dose of atropin sulphate ($\frac{1}{60}$ grain) should be

given, but not repeated. Inhalations of oxygen and artificial respiration may be necessary.

What must be kept in mind during the treatment? Remember that the treatment must be persevered in; as long as life lasts there is hope of recovery.

What other substances besides those mentioned may be used as antagonists against morphin? Borax, 5 per cent in milk, animal charcoal, compound solution of iodin (Lugol's solution) in small doses.

Name a few simple tests for the alkaloid morphin. Nitric acid produces an orange-red color, turning yellow, then disappearing. A test solution of ferric chlorid will produce a blue color, turning green with an excess of the reagent; this color is destroyed by free acids, but is not by alkalis.

What are the symptoms of poisoning by aconite? Anxious countenance; cold, clammy skin; perspiration; great muscular weakness; dim sight; shallow, irregular, and labored breathing; anesthesia in a general way all over the body; and death from paralysis of the heart and respiration.

What is the treatment of aconite poisoning? Place the patient in the recumbent position; administer some form of tannin, preferably tea or strong coffee; apply heat to the extremities; use the stomach tube to empty stomach; administer such stimulants as ether, brandy, or aromatic spirit of ammonia.

What are the symptoms of strychnin poisoning? A sense of suffocation and inability to breathe, shuddering and jerking of the muscles, sense of stiffness about the neck, bitter taste in mouth, twitching and jerking of lower limbs, quivering of the whole frame; the limbs are rigid and the body becomes arched so that it rests on the head and heels (opisthotonos, or, if arching occurs on the toes and forehead, emprosthotonos; on the side of the head and the side of the foot, pleurosthotonos); the features assume a peculiar grin (risus sardonicus). Nearly all the muscles of the body are affected, but the jaw muscles are not seriously implicated until the last. The pulse becomes rapid and the temperature is above the normal; the intellect is not affected until the end, the patient

being aware at all times as to what is going on about him. The spasms brought on by strychnin are not of long duration; they may last for a few minutes and then there will be a period of relaxation; during this period the patient suffers from soreness of the muscles, feels exhausted, and begins to sweat profusely, but soon is aware that another spasm is about to come on and will cry out for help, and will perhaps ask that he be rubbed or turned over. During the spasm the eyeballs are very prominent and there is involuntary urination and defecation.

What is the treatment of strychnin poisoning? Emetics are to be given and repeated until very free vomiting is induced. Potassium permanganate (20 grains to the pint) should be used as a chemical antagonist; if this is not at hand, some form of tannin should be used. Chloroform is given to relieve pain and spasm. Chloral hydrate and potassium bromid (large doses) are also useful. All procedures in treating a case of strychnin poisoning should be carried out with the patient in the recumbent position, remote from noises, and in a dark room.

What are the symptoms of poisoning by atropin? Redness or rash of skin; nose, mouth, throat, and bronchi become dry; voice becomes hoarse, swallowing becomes difficult, heart action becomes rapid, vision is disordered, the pupils of the eye are dilated, and there is a predisposition to laugh and talk loudly. If the dose be very large, there will be wild and maniacal delirium, physical and mental depression, suppression of the urine, convulsions, and death.

How does death occur in atropin poisoning? Death occurs from asphyxia combined with heart failure.

Name some of the plants that will produce the same symptoms of poisoning as atropin. Hyoscyamus, strammonium, scopola and an unofficial plant named *Duboisia;* these are all derivatives of the *Solanaceæ* family and are closely allied to belladonna, from which atropin is obtained.

What is the treatment of atropin poisoning? Wash out the stomach with a solution of potassium permanganate (20 grains to 1 pint water); if this is not available, administer an emetic,

give hypodermic injection of morphin; pilocarpin is useful for its effect on salivation. Apply an ice cap to the head, stimulate with strong coffee, and eliminate the poison absorbed by the use of cathartics and diuretics.

What are the symptoms of cocain poisoning? Excitement, talkativeness, followed by marked depression, small, rapid pulse, slow respiration, cyanosis, dilated pupils, collapse.

What is the treatment of cocain poisoning? Wash out the stomach with a solution of potassium permanganate (20 grains to 1 pint water), recumbent position, external heat, artificial respiration in case of respiratory failure, and morphin as a physiological antagonist.

What are the symptoms of poisoning by alcohol? Intoxication by alcohol in any form produces exhilaration, staggering gait, deep sleep with stertorous breathing, acute gastritis, profound depression.

What is the treatment of alcohol poisoning? Emetics or the use of the stomach tube, purgatives, proper diet, external heat.

What disease is attributable to alcohol? Delirium tremens, which frequently occurs after an alcoholic debauch.

What are the symptoms produced by wood-alcohol poisoning? The same as for alcohol, except that wood alcohol may cause permanent blindness and has caused death when taken in small doses. The treatment for this poison is the same as for alcohol.

Why is wood alcohol so highly poisonous? Because it is oxidized in the system only partially and forms the highly poisonous formic acid.

CHAPTER 13.

CLERICAL DUTIES.

The clerical work required in performing the duties charged to the Medical Department of the Navy at hospitals, shore stations, and on board ships is performed largely by members of the Hospital Corps of the Navy, and is incidental to their most important duty, namely, the care and comfort of the sick and wounded.

For a member of the Hospital Corps to perform such clerical work satisfactorily it is necessary: (1) That he be conversant with the Navy and its personnel as at present constituted; (2) that he have a knowledge of the history and establishment of the Bureau of Medicine and Surgery, the regulations defining its duties, and the sources and applications of moneys under its control; (3) that he thoroughly understand the duties ashore and afloat with which the Medical Department of the Navy, of which he is an integral part, is charged; and (4) that his work be uniformly neat and accurate.

DEPARTMENT OF THE NAVY.

The President is, by the Constitution, the Commander in Chief of the Navy.

The Navy Department is one of the 10 executive departments of the United States Government, and is charged with the general control and administration of the Navy.

At the head of this department is the Secretary of the Navy, a civil officer and a member of the Cabinet, appointed by the President, by and with the advice and consent of the Senate. He performs such duty as the President of the United States

may assign him and has the general superintendence of construction, manning, armament, equipment, and employment of vessels of war.

The Secretary's deputy is the Assistant Secretary of the Navy.

Navy Department Bureaus.

For purposes of administration and segregation of duties the Navy Department is divided into the Office of Naval Operations and seven bureaus, each charged with certain specific duties and in charge of an officer of the Navy appointed by the President of the United States, by and with the advice and consent of the Senate. The chiefs of the several bureaus of the Navy Department are appointed for four years and hold the rank of rear admiral while performing such duties. The chief of naval operations holds the rank of admiral.

The following is a list of the offices above enumerated and of the officers in charge:

Office of Naval Operations	Chief of Naval Operations.
Navigation	Chief of the Bureau.
Yards and Docks	Chief of the Bureau.
Ordnance	Chief of the Bureau.
Construction and Repair	Chief Constructor and Chief of the Bureau.
Steam Engineering	Engineer in Chief and Chief of the Bureau.
Medicine and Surgery	Surgeon General and Chief of the Bureau.
Supplies and Accounts	Paymaster General and Chief of the Bureau.

These are charged with the following duties:

OFFICE OF NAVAL OPERATIONS.

During the temporary absence of the Secretary and the Assistant Secretary of the Navy the chief of naval operations

is next in succession to act as Secretary of the Navy. (Act Mar. 3, 1915.) The chief of naval operations, while so serving as such chief of naval operations, has the rank and title of admiral, to take rank next after the Admiral of the Navy. (Act Aug. 29, 1916.)

The chief of naval operations, under the direction of the Secretary of the Navy, is charged with the operations of the fleet and with the preparation and readiness of plans for its use in war. (Act Mar. 3, 1915.) This includes the direction of the Naval War College, the Office of Naval Intelligence, the Office of Gunnery Exercises and Engineering Performances, the operation of the Radio Service and of other systems of communication, the operations of the Aeronautic Service, of Mines and Mining, of the Naval Defense Districts, Naval Militia, and of the Coast Guard when operating with the Navy; the direction of all strategic and tactical matters, organization, maneuvers, target practice, drills and exercises, and of the training of the fleet for war; and the preparation, revision, and enforcement of all tactics, drill books, signal codes, and cipher codes.

The chief of naval operations is charged with the preparation, revision, and record of Regulations for the Government of the Navy, Naval Instructions, and General Orders. He advises the Secretary concerning the movements and operations of vessels of the Navy and prepares all orders issued by the Secretary in regard thereto and keeps the records of service of all fleets, squadrons, and ships. He advises the Secretary in regard to the military features of all new ships and as to any proposed extensive alterations of a ship which will affect her military value and all features which affect the military value of dry docks, including their location; also as to matters pertaining to fuel reservations and depots, the location of radio stations, reserves of ordnance and ammunition, fuel, stores, and other supplies of whatsoever nature, with a view to meeting effectively the demands of the fleet.

In preparing and maintaining in readiness plans for the use of the fleet in war he freely consults with and has the advice

and assistance of the various bureaus, boards, and offices of the department, including the Marine Corps headquarters, in matters coming under their cognizance. After the approval of any given war plans by the Secretary it is the duty of the chief of naval operations to assign to the bureaus, boards, and offices such parts thereof as may be needed for the intelligent carrying out of their respective duties in regard to such plans.

The chief of naval operations is charged with matters pertaining to the operation of aircraft and aircraft stations. He has supervision of the training of officers and men in the Aeronautic Service.

The chief of naval operations from time to time witnesses the operations of the fleet as an observer.

He has two principal senior assistants, officers not below the grade of captain, one as assistant for operations and the other as assistant for matériel.

He is *ex officio* a member of the General Board.

Under the Office of Naval Operations are the following:

COMMUNICATION OFFICE.—The Communication Office, under the director of naval communications, handles all the dispatch work of the Navy Department. A commissioned officer is on watch in the Communication Office at all times, night and day, and is responsible for the routing, coding, and decoding of all dispatches. He is responsible for the proper delivery of all received official messages. The assistant communication officer on watch keeps himself informed of the general dispatches received outside of departmental hours, and is responsible that dispatches of importance requiring immediate action are communicated as soon as possible to the proper officer.

OFFICE OF NAVAL INTELLIGENCE.—The Office of Naval Intelligence is charged with the collection, classification, and dissemination of such technical information at home and abroad as will be useful to the chief of naval operations and to the various bureaus of the Navy Department in the formulation of plans for war and in the development of personnel and matériel.

OFFICE OF GUNNERY EXERCISES AND ENGINEERING PERFORMANCES.—The Office of Gunnery Exercises and Engineering Per-

formances is charged with the duties, under the chief of naval operations, of formulating the rules for all forms of gunnery exercises and steaming performances; computing, compiling, and publishing in confidential form the results and records of these competitions; the award of prizes, trophies, and commendatory letters in connection therewith, these exercises being the means to the end—i. e., battle efficiency of the fleet.

NAVAL COMMUNICATION SERVICE.—The Office of Director of Naval Communications is established under the chief of naval operations. The director of naval communications is charged with matters pertaining to the operation of naval radio stations ashore, and in addition is charged with the duties in connection with and is responsible for the efficient handling of all telegraph, telephone, and cable, and generally all dispatch work between the Navy Department and the fleet and throughout the naval service outside the fleet. In his administration of the foregoing he has general charge of the operation, organization, and administration of the Communication Service. He cooperates with officials designated by the Secretary of Commerce in reference to the proposed location of commercial radio stations, the licensing of operators, the control of the operation of commercial radio stations under the law, and the assignment of wave lengths for use by commercial stations which will comply with the law and prevent interference with the radio work of the Naval Communication Service.

BUREAU OF NAVIGATION.

The duties of the Bureau of Navigation comprise the issue, record, and enforcement of the orders of the Secretary to the individual officers of the Navy; the training and education of line officers and of enlisted men (except of the Hospital Corps) at schools and stations and in vessels maintained for that purpose; the upkeep and operation of the Naval Academy, of technical schools for line officers, of the apprentice-seaman establishments, of schools for the technical education of enlisted men, and of the naval home at Philadelphia, Pa.; the

upkeep and the payment of the operating expenses of the Naval War College; the enlistment, assignment to duty, and discharge of all enlisted persons.

It has under its direction all rendezvous and receiving ships and provides transportation for all enlisted persons under its cognizance.

It establishes the complements of all ships in commission.

It keeps the records of service of all officers and men and prepares an annual Navy Register for publication, embodying therein data as to fleets, squadrons, and ships, which are furnished by the chief of naval operations. To the end that it may be able to carry out the provisions of this paragraph, all communications to or from ships in commission relating to the personnel of such ships are forwarded through this bureau, whatever their origin.

It is charged with all matters pertaining to applications for appointments and commissions in the Navy and with the preparation of such appointments and commissions for signature.

It is charged with the preparation, revision, and enforcement of all regulations governing uniform, and with the distribution of all orders and regulations of a general or circular character.

Questions of naval discipline, rewards, and punishments are submitted by this bureau for the action of the Secretary of the Navy. The records of all general courts-martial and courts of inquiry involving the personnel of the Navy before final action are referred to this bureau for comment as to disciplinary features.

It receives and brings to the attention of the Secretary of the Navy all applications from officers for duty or leave.

It receives all reports of services performed by individual officers or men.

It is charged with the enforcement of regulations and instructions regarding naval ceremonies and naval etiquette.

It is charged with the upkeep and operation of the Hydrographic Office, the Naval Observatory, Nautical Almanac, and compass offices. It has charge of all ocean and lake surveys

and ships' and crews' libraries; it defrays the expenses of pilotage of all ships in commission.

It is charged with the formation of the Naval Reserve and with all matters relating thereto, and has supervision of the Naval Militia.

Under the Bureau of Navigation are the following:

NAVAL OBSERVATORY.—The Naval Observatory, at Washington, D. C., and the Navy Chronometer Time Station, at the navy yard, Mare Island, Cal., furnish the country standard time each day both by telegraph and radio, and the adjacent oceans by radio, the former supplying that part of the country east of the Rocky Mountains and the latter that part west. The Naval Observatory supervises the outfits of instruments for the naval service and keeps up continuous fundamental observations of the heavenly bodies for the use of the Nautical Almanac Office, which prepares the American Ephemeris and Nautical Almanac and the American Nautical Almanac each year for the use of navigators, surveyors, and others requiring the positions and movements of the heavenly bodies.

HYDROGRAPHIC OFFICE.—The Hydrographic Office is charged with marine surveys in foreign waters and with the collection and dissemination of hydrographic and navigational data; the preparation and printing of maps and charts relating to and required in navigation; the preparation of navigator's sailing directions or pilots, and manuals of instruction for the use of all vessels of the United States and for the benefit and use of navigators generally; the furnishing of the foregoing to the Navy and other public services; and their sale to the mercantile marine and the public at the cost of printing and paper.

DIVISION OF NAVAL MILITIA AFFAIRS.—The Division of Naval Militia Affairs is charged with the transaction of business pertaining to the Naval Militia of the several States of the Union having such organizations, including the District of Columbia, its jurisdiction embracing all administrative duties involving the armament, equipment, discipline, training, education, and organization of the Naval Militia; the relations of the Naval Militia to the Regular Navy in time of peace; the conduct of

cruises of instruction of the Naval Militia on vessels loaned to the States and on vessels of the Regular Navy, and the conduct of armory and other instruction; and all other matters pertaining to the Naval Militia not herein generically enumerated which do not under existing laws, regulations, orders, and practice come within the jurisdiction of any division or bureau of the Navy Department. It is the office of record for all matters pertaining to the Naval Militia when not in the service of the United States.

BUREAU OF YARDS AND DOCKS.

The duties of the Bureau of Yards and Docks comprise all that relates to the design and construction of public works, such as dry docks, marine railways, building ways, harbor works, quay walls, piers, wharves, slips, dredging, landings, floating and stationary cranes, power plants, coaling plants; heating, lighting, telephone, water, sewer, and railroad systems; roads, walks, and grounds; bridges, radio towers, and all buildings, for whatever purpose needed, under the Navy and Marine Corps. It provides for the general maintenance of the same, except at the naval proving ground, the naval torpedo station, the naval training stations, the Naval Academy, the naval magazines, naval hospitals, and marine posts. It designs and makes the estimates for the public works after consulting as to their operating features with the bureau or office for whose use they are primarily intended. It has charge of all means of transportation, such as derricks, shears, locomotives, locomotive cranes, cars, motor trucks, and all vehicles, horses, teams, subsistence, and necessary operators and teamsters in the navy yards. It provides the furniture for all buildings except at the naval magazines, hospitals, the Naval Academy, and marine posts. It provides clerks for the office of the commandant, captain of the yard, and public works officer. In general, the work of the bureau is carried out by commissioned officers of the Corps of Civil Engineers, United States Navy, whose major duties comprise the construction and maintenance of the public works of the Navy.

BUREAU OF ORDNANCE.

The duties of the Bureau of Ordnance comprise all that relates to the upkeep, repair, and operation of the torpedo station, naval proving ground, and magazines on shore, to the manufacture of offensive and defensive arms and apparatus (including torpedoes and armor), all ammunition, and war explosives. It requires for or manufactures all machinery, apparatus, equipment, material, and supplies required by or for use with the above.

It determines the interior dimensions of revolving turrets and their requirements as regards rotation.

As the work proceeds it inspects the installation of the permanent fixtures of the armament and its accessories on board ship, and the methods of stowing, handling, and transporting ammunition and torpedoes, all of which work shall be performed to its satisfaction. It designs and constructs all turret ammunition hoists, determines the requirements of all ammunition hoists, and the method of construction of armories and ammunition rooms on shipboard, and in conjunction with the Bureau of Construction and Repair determines upon their location and that of all ammunition hoists outside the turrets. It installs all parts of the armament and its accessories which are not permanently attached to any portion of the structure of the hull, excepting turret guns, turret mounts, and ammunition hoists, and such other mounts as require simultaneous structural work in connection with installation or removal. It confers with the Bureau of Construction and Repair respecting the arrangements for centering the turrets and the character of the roller paths and their supports.

It has cognizance of all electrically operated ammunition hoists, rammers, and gun-elevating gear which are in turrets; of electric training and elevating gear for gun mounts not in turrets; of electrically operated air compressors for charging torpedoes; and of all range finders and battle-order and range transmitters and indicators.

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BUREAU OF CONSTRUCTION AND REPAIR.

The duties of the Bureau of Construction and Repair comprise the responsibility for the structural strength and stability of all ships for the Navy; all that relates to designing, building, fitting, and repairing the hulls of ships, turrets, and electrical turret-turning machinery, spars, capstans, windlasses, deck winches, boat cranes, steering gear, and hull-ventilating apparatus (except portable fans), and after consultation with the Bureau of Ordnance and according to the requirements thereof as determined by that bureau, the designing, construction, and installation of independent ammunition hoists, the same to conform to the requirements of the Bureau of Ordnance as to power, speed, and control, and the installation of the permanent fixtures of all other ammunition hoists and their appurtenances; placing and securing armor, placing and securing on board ship to the satisfaction of the Bureau of Ordnance the permanent fixtures of the armament and its accessories as manufactured and supplied by that bureau; installing the turret guns, turret mounts, and turret ammunition hoists, and such other mounts as require simultaneous structural work in connection with installations or removal.

It has charge of the docking of ships and is charged with the operating and cleaning of dry docks.

It is responsible for the care and preservation of ships not in commission.

It has cognizance of electric launches and other boats supplied with electric motive power.

It has charge of the manufacture of anchors and cables; the supplying and fitting of rope, cordage, rigging, sails, awnings, and other canvas, and flags and bunting; it supplies to the satisfaction of the Bureau of Supplies and Accounts galley ranges, steam cookers, and other permanent galley fittings, and installs and repairs the same.

It supplies and installs, in consultation with the Bureau of Steam Engineering, all voice tubes and means of mechanical signal communications.

BUREAU OF STEAM ENGINEERING.

The duties of the Bureau of Steam Engineering comprise all that relates to designing, building, fitting out, and repairing machinery used for the propulsion of naval ships; the steam pumps, steam heaters, distilling apparatus, refrigerating apparatus, all steam connections of ships, and the steam machinery necessary for actuating the apparatus by which turrets are turned.

It has cognizance of the entire system of interior communications. It is specifically charged with the design, supply, installation, maintenance, and repair of all means of interior and exterior electric signal communications (except range finders and battle-order and range transmitters and indicators), and of all electrical appliances of whatsoever nature on board naval vessels, except motors and their controlling apparatus used to operate the machinery belonging to the other bureaus.

It has charge of the design, manufacture, installation, maintenance, repair, and operation of wireless telegraph outfits on board ship and of wireless telegraph outfits and stations on shore.

It has charge of the design, manufacture, installation, maintenance, repair, and operation of airplane motors and propellers and their attachments.

It has supervision and control of the engineering experiment station.

It designs the various shops at navy yards and stations where its own work is executed, so far as their internal arrangements are concerned.

BUREAU OF MEDICINE AND SURGERY.

The Bureau of Medicine and Surgery has charge of the upkeep and operation of all hospitals and of the force employed there; it advises with respect to all questions connected with hygiene and sanitation affecting the service; it provides for physical examinations; it passes upon the competency from a professional standpoint of all men in the Hospital Corps for enlistment and

promotion by means of examinations conducted under its supervision, or under forms prescribed by it; it has information as to the assignment and duties of all enlisted men of the Hospital Corps; it recommends to the Bureau of Navigation the complement of medical officers, dental officers, and Hospital Corps for hospital ships, and has power to appoint and remove all nurses in the Nurse Corps (female), subject to the approval of the Secretary of the Navy.

Except as otherwise provided for, the duties of the Bureau of Medicine and Surgery include the upkeep and operation of medical supply depots, medical laboratories, naval hospitals, dispensaries, technical schools for the Medical and Hospital Corps, and the administration of the Nurse Corps (female), Dental Corps, and Medical and Dental Reserve Corps.

It approves the design of hospital ships in so far as relates to their efficiency for the care of the sick and wounded.

It requires for all supplies, medicines, and instruments used in the Medical Department of the Navy. It has control of the preparation, reception, storage, care, custody, transfer, and issue of all supplies of every kind used in the Medical Department for its own purposes.

BUREAU OF SUPPLIES AND ACCOUNTS.

The duties of the Bureau of Supplies and Accounts comprise all that relates to the purchase, reception, storage, care, custody, transfer, shipment, and issue of all supplies for the Naval Establishment, and the keeping of property accounts for the same (except supplies for the Marine Corps); the procuring of provisions, clothing, and small stores, and material under the naval supply account. This fund, which is administered by the Bureau of Supplies and Accounts, governs the charging, crediting, receipt, purchase, transfer, manufacture, repair, issue, and consumption of all stores for the Naval Establishment, except for a few items which are specifically exempted. The two naval clothing factories also come under the control of this bureau.

It also procures all coal and fuel for steamers' and ships' use, including expenses of transportation, storage, and handling the

same, and water for all purposes on board naval vessels, including the expense of transportation and storage of the same.

The duties also comprise all that relates to the supply of funds for disbursing officers, payment for articles and services for which contract and agreement have been made, and the keeping of the money accounts in the Naval Establishment, including accounts of all manufacturing and operating expense at the navy yards and stations; and the preparation of estimates for the pay of all officers and enlisted men of the Navy.

JUDGE ADVOCATE GENERAL AND SOLICITOR.

Attached to the Secretary of the Navy's office are the Office of the Judge Advocate General of the Navy and the Office of the Solicitor of the Navy. The Judge Advocate General of the Navy is appointed for four years by the President, by and with the advice and consent of the Senate, from the officers of the Navy or Marine Corps, and has the rank of captain in the Navy or colonel in the Marine Corps, as the case may be.

The solicitor is appointed from civil life by the Secretary of the Navy.

OFFICE OF THE JUDGE ADVOCATE GENERAL.

The duties of the Judge Advocate General of the Navy are as follows: To revise and report upon the legal features of and have recorded the proceedings of all courts-martial, courts of inquiry, boards of investigation, inquest, and boards for the examination of officers for retirement and promotion in the naval service; to prepare charges and specifications for courts-martial, and the necessary orders convening courts-martial in cases where such courts are ordered by the Secretary of the Navy; to prepare court-martial orders promulgating the final action of the reviewing authority in court-martial cases; to prepare the necessary orders convening courts of inquiry in cases where such courts are ordered by the Secretary of the Navy, and boards for the examination of officers for promotion and retirement, and for the examination of candidates for appointment

as commissioned officers in the Navy other than midshipmen, and to conduct all official correspondence relating to such courts and boards. It is also the duty of the Judge Advocate General to examine and report upon all questions relating to rank and precedence, to promotions and retirements, and those relating to the validity of proceedings in court-martial cases; all matters relating to the supervision and control of naval prisons and prisoners, including prisoners of war; disciplinary ships and detentioners; the removal of the mark of desertion; the correction of records of service and reporting thereupon in the Regular or Volunteer Navy; certification of discharge in true name; pardons, bills, and resolutions introduced in Congress relating to the personnel referred to the department for report, and the drafting and interpretation of statutes relating to the personnel; references to the Comptroller of the Treasury with regard to pay and allowances of the personnel; questions involving points of law concerning the personnel; proceedings in the civil courts in all cases concerning the personnel as such; and to conduct the correspondence respecting the foregoing duties, including the preparation for submission to the Attorney General of all questions relating to subjects coming under his own cognizance which the Secretary of the Navy may direct to be so referred. The study of international law is assigned to the office of the Judge Advocate General. He examines and reports upon questions of international law as may be required.

OFFICE OF THE SOLICITOR.

The duties of the solicitor comprise and relate to examination and report upon questions of law, including the drafting and interpretation of statutes and matters submitted to the accounting officers not relating to the personnel; preparation of advertisements, proposals, and contracts; insurance; patents; the sufficiency of official, contract, and other bonds and guaranties; proceedings in the civil courts by or against the Government or its officers in cases relating to material and not concerning the personnel as such; claims by or against the Government; questions submitted to the Attorney General, except such

as are under the cognizance of the Judge Advocate General; bills and congressional resolutions and inquiries not relating to the personnel and not elsewhere assigned; the searching of titles, purchase, sale, transfer, and other questions affecting lands and buildings pertaining to the Navy; the care and preservation of all muniments of title to land acquired for naval uses; and the correspondence respecting the foregoing duties; and rendering opinion upon any matter or question of law referred to him by the Secretary or Assistant Secretary.

PERSONNEL OF THE NAVY.

To comprehend clearly matters pertaining to the personnel of the Navy it is necessary to understand the general divisions of this personnel and the several corps comprising it, as well as the different ranks or grades of the officers and the many ratings held by the enlisted men.

The personnel of the Navy is composed of officers and enlisted men, their numbers varying in accordance with the authorized strength of the Navy allowed by law, and regulated largely by service requirements.

An officer is one appointed to a certain rank and authority by the President of the United States by and with the advice and consent of the Senate. In the Navy an officer is appointed by either commission or warrant. This divides the officers as a whole into two classes, commissioned officers and warrant officers.

An officer's tenure in the Navy is for life, unless sooner terminated by removal, resignation, disability, or other casualty.

The enlisted men of the Navy, as the term indicates, are enlisted or engaged for periods of service, at present four years, and discharged from the service at the expiration of such enlistment. At the expiration of an enlistment they can reenlist for a variable period of from one to four years.

COMMISSIONED OFFICERS OF THE LINE.

Commissioned officers of "the line" are those who succeed to a command and who automatically assume command in order

of senority, even in the presence of staff officers of higher rank.

Officers of the line in the Navy, with the exception of men promoted from the warrant grades, are all graduates of the Naval Academy at Annapolis, Md., where they receive training by the Government in the duties essential to naval science. While attending the Naval Academy they rank as midshipmen; midshipmen, though not commissioned, enjoy privilege and consideration as officers of the Navy. Upon graduation midshipmen are commissioned ensigns.

The commissioned officers of the line in the Navy have rank as admiral, vice admiral, rear admiral, captain, commander, lieutenant commander, lieutenant, lieutenant (junior grade), and ensign.

COMMISSIONED OFFICERS OF THE STAFF.

The staff is a body of officers not having command but intrusted with special duties peculiar to their training. They may be classed as specialists in particular professions who receive their training in civil life, and are appointed in the Navy after passing a professional examination. (An exception to this is the Corps of Naval Constructors, which is made up of officers selected from the graduates of the Naval Academy.)

The commissioned staff of the Navy comprises medical officers, dental officers, pay officers, chaplains, professors of mathematics, naval constructors, and civil engineers. These officers are divided into corps in accordance with the designation of their professions as indicated, i. e., Medical Corps, Medical Reserve Corps, Dental Corps, Dental Reserve Corps, Pay Corps, Corps of Chaplains, Corps of Professors of Mathematics, Construction Corps, and Corps of Civil Engineers.

The Medical Corps of the Navy, of particular interest to men in the Hospital Corps, is comprised of medical officers having the following grades: Medical director, medical inspector, surgeon, passed assistant surgeon, assistant surgeon, and acting assistant surgeon.

WARRANT OFFICERS.

Warrant officers in the Navy are of two classes, the higher (called chief warrant officers) ranking with, but after, ensigns and the other ranking with, but after, midshipmen. A warrant officer is eligible for promotion to chief warrant officer after six years' service as such and after passing a satisfactory examination prescribed by the Secretary of the Navy. A chief warrant officer, after six years from date of commission, receives the pay and allowances of a lieutenant (junior grade); after twelve years from date of commission, the pay and allowances of a lieutenant.

There are seven divisions of warrant officers, as follows: Boatswains, gunners, machinists (belong to the line). carpenters, sailmakers, pharmacists, and pay clerks (belong to the staff).

Enlisted Personnel.

As previously mentioned, all enlisted men enter the Navy for a stated period.

The enlisted force of the Navy is divided into five branches—seaman, artificer, special, messman, marine. Several of these branches have assimilated ratings, and the tabular classification entered below, taken from the Navy Regulations, will make clear the several branches with their different ratings.

CHIEF PETTY OFFICERS.

Seaman branch.	Artificer branch.	Special branch.	Marines.
Chief masters at arms.	Chief machinist's mates.	Chief yeomen.	Sergeants major.
Chief boatswain's mates.	Chief electricians.	Chief pharmacist's mates.	First sergeants.
	Chief printers.		Gunnery sergeants.
Chief gunner's mates.	Chief carpenter's mates.	Bandmasters.	Quartermaster sergeants.
Chief turret captains.	Chief water tenders.	Chief commissary stewards.	Drum majors.
Chief gun captains.	Chief storekeepers.		Leaders of band.
Chief quartermasters.			Second leaders of band.

PETTY OFFICERS, FIRST CLASS.

Seaman branch.	Artificer branch.	Special branch.	Marines.
Masters at arms, first class.	Machinist's mates, first class.		
Boatswain's mates, first class.	Electricians, first class.	Yeomen, first class.	
		Pharmacist's mates, first class.	
		First musicians.	
Turret captains, first class.	Boilermakers.	Commissary stewards	
Gunner's mates, first class.	Coppersmiths.	Ship's cooks, first class.	
Gun captains, first class	Blacksmiths.	Bakers, first class.	
Quartermasters, first class.	Plumbers and fitters.		
	Sailmaker's mates.		
	Carpenter's mates, first class.		
	Water tenders.		
	Ship's fitters, first class.		
	Painters, first class.		
	Storekeepers, first class.		
	Printers, first class.		

PETTY OFFICERS, SECOND CLASS.

Masters at arms, second class.	Machinist's mates, second class.	Yeomen, second class.	Sergeants.
		Pharmacist's mates, second class.	
Boatswain's mates, second class.	Electricians, second class.	Ship's cooks, second class.	
Gunner's mates, second class.	Carpenter's mates, second class.		
Gun captains, second class.			
Quartermasters, second class.	Oilers.		
	Ship's fitters, second class.		
	Painters, second class.		

PETTY OFFICERS, THIRD CLASS.

Masters at arms, third class.	Electricians, third class.	Yeomen, third class.	Corporals.
Coxswains.	Carpenter's mates, third class.	Pharmacist's mates, third class.	
Gunner's mates, third class.	Painters, third class.		
Quartermasters, third class.			

SEAMEN, FIRST CLASS.

Seaman branch.	Artificer branch.	Special branch.	Marines.
Seaman gunners. Seamen, first class.	Firemen, first class.	Hospital apprentices, first class. Musicians, first class. Ship's cooks, third class. Bakers, second class.	Musicians. Privates.

SEAMEN, SECOND CLASS.

Seamen, second class.	Firemen, second class. Shipwrights.	Musicians, second class. Buglers. Hospital apprentices, second class. Ship's cooks, fourth class.	

SEAMEN, THIRD CLASS.

Apprentice seamen.	Firemen, third class. Landsmen.	Bandsmen.	

MESSMAN BRANCH.

Stewards to commanders in chief. Cooks to commanders in chief. Stewards to commandants. Cooks to commandants. Cabin stewards. Cabin cooks. Wardroom stewards. Wardroom cooks.	Steerage stewards. Steerage cooks. Warrant officers' stewards. Warrant officers' cooks. Mess attendants, first class. Mess attendants, second class. Mess attendants, third class.

The Fleet and the Naval Stations for Its Upkeep.

The Navy is primarily the fleet—the vessels of war with their auxiliaries.

The composition of the fleet includes battleships, armored cruisers, cruisers, monitors, destroyers, submarines, gunboats, transports, supply ships, fuel ships, hospital ships, tugs, and

tenders, and is divided as follows: Atlantic Fleet, Pacific Fleet, Asiatic Fleet, unattached vessels in active service.

The Navy Department has under its control a number of naval stations, both at home and in its outlying territories and possessions. The most important of these, with their locations, are as follows:

Navy yards or stations at Portsmouth, N. H.; Boston, Mass.; New York; Philadelphia, Pa.; Norfolk, Va.; Charleston, S. C.; Mare Island, Cal.; Puget Sound, Wash.; Pearl Harbor, Hawaii; Guam; Cavite and Olongapo, P. I. Naval training stations at Newport, R. I.; Norfolk, Va.; Great Lakes, Ill.; and San Francisco, Cal. Naval Academy at Annapolis, Md. Gun factory at Washington, D. C. Torpedo station at Newport, R. I. Ordnance proving ground at Indianhead, Md., and magazines and depots for storage of combustibles, etc.

The following definitions taken from United States Navy Regulations and Naval Instructions (I 5354) will be of interest in connection with this subject:

"A naval station is any establishment for building, manufacturing, docking, repair, supply, or training under the control of the Navy. It may include several such establishments.

"A navy yard is a single establishment for docking, repair, and supply. It may include building and manufacturing facilities. Either alone or with other naval establishments it constitutes a naval station.

"A naval base is a point from which naval operations may be conducted and which is selected for that purpose. Its essential feature is an adequate anchorage for a fleet with its auxiliaries, preferably sheltered from the sea and fortified against attack. Naval bases are permanent or temporary. The latter would generally be established nearer the theater of war than any permanent base, and would be called an advanced base. A permanent base would have docking and repair facilities.

"Strategy applies to the distribution of naval forces, their armament and supplies, in preparation for war or in the prosecution of war. It includes logistics. It refers to naval movements and dispositions made before contact with the enemy's forces.

"Tactics applies to all naval movements and operations made after contact with the enemy's forces. The term 'contact' is here employed in a broad sense, meaning such proximity to the enemy as affects fleet formation and renders a battle imminent.

"Naval policy.—Everything that includes the fixed condition of preparation for war; that is, the strength, character, and composition of the Navy, fortification of ports and bases, etc. (This will be based upon our political relations and the probability of war with different powers. It will also be influenced by the conclusions of a comprehensive study of the political relations between other powers throughout the world and their influence upon coalitions and alliances.)"

United States Marine Corps.

The United States Marine Corps forms a military branch of the Navy under control of the Secretary of the Navy, and is subject to the laws and regulations for the government of the Navy. The United States Marine Corps may, by order of the President of the United States, be detached for service with the United States Army, when it becomes subject to the rules and articles of war prescribed for the government of the Army.

The headquarters of the United States Marine Corps is in Washington, D. C. The head of the Marine Corps is designated commandant of the Marine Corps, has the rank of a major general, and is appointed from officers in the Marine Corps by the President, by and with the advice and consent of the Senate, for four years.

The commandant of the Marine Corps is charged with the following duties: The commandant of the Marine Corps is responsible to the Secretary of the Navy for the general efficiency and discipline of the corps, makes such distribution of officers and men for duty at the several shore stations as shall appear to him to be most advantageous for the interests of the service; furnishes detachments for vessels for the Navy, according to the authorized scale of allowance; under the direction of the Secretary of the Navy, issues orders for the movement of officers

and troops and such other orders and instructions for their guidance as may be necessary and has charge and exercises general supervision and control of the recruiting service of the corps and of the necessary expenses thereof, including the establishment of recruiting stations.

The duties of the United States Marine Corps are defined by an Executive order of November 12, 1908, as follows:

"To garrison the different navy yards and naval stations, both within and beyond the continental limits of the United States.

"To furnish the first line of the mobile defense of naval bases and naval stations beyond the continental limits of the United States.

"To man such naval defenses and to aid in manning, if necessary, such other defenses as may be erected for the defense of naval bases and naval stations beyond the continental limits of the United States.

"To garrison the Isthmian Canal Zone, Panama.

"To furnish such garrisons and expeditionary forces for duties beyond the seas as may be necessary in time of peace."

THE BUREAU OF MEDICINE AND SURGERY.

As previously stated, the business of the Navy Department is conducted through bureaus, one of which is the Bureau of Medicine and Surgery. The existence of this bureau as a separate and distinct bureau in the Navy Department dates from its establishment by Congress, with other Navy Department bureaus, in the act of August 31, 1842.

From the inception of our Government to August 31, 1842, the history of the Medical Department of the Navy is interwoven with that of other branches of the service. (For a history of these events see United States Naval Medical Bulletin, vii, No. 1, p. 39, et seq.)

The following is a list of the names of the chiefs of the Bureau of Medicine and Surgery and Surgeons General, United States Navy, from 1842 to date:

CHIEFS OF BUREAU.

(Act of August 31, 1842.)

William P. C. Barton	Sept. 2, 1842, to Apr.	1, 1844
Thomas Harris	Apr. 1, 1844, to Sept.	30, 1853
William Whelan	Oct. 1, 1853, to June	11, 1865
P. J. Horwitz	July 1, 1865, to June	30, 1869

Chiefs of Bureau, with relative rank and pay of commodore, and title of Surgeon General. (Act of March 3, 1871.)

William M. Wood	July 1, 1869, to Oct.	31, 1871
J. M. Foltz	Nov. 1, 1871, to June	8, 1872
J. C. Palmer	June 10, 1872, to July	8, 1873
Joseph Beale	July 9, 1873, to Feb.	2, 1877
William Grier	Feb. 3, 1877, to Oct.	5, 1878
J. W. Taylor	Oct. 28, 1878, to Aug.	19, 1879
P. S. Wales	Aug. 20, 1879, to Jan.	27, 1884
F. M. Gunnell	Apr. 1, 1884, to Apr.	1, 1888
J. M. Browne	Apr. 2, 1888, to May	10, 1893
J. R. Tryon	May 11, 1893, to Sept.	7, 1897
N. L. Bates	Oct. 1, 1897, to Oct.	18, 1897

Chiefs of Bureau, with rank of rear admiral, title of Surgeon General, and pay and allowances of brigadier general in the Army. (Act of March 3, 1879.)

W. K. VanReypen	Oct. 23, 1897, to Jan.	25, 1902
P. M. Rixey	Feb. 5, 1902, to Feb.	4, 1910
C. F. Stokes	Feb. 7, 1910, to Feb.	6, 1914
W. C. Braisted	Feb. 7, 1914, present incumbent.	

Duties.

The duties of the Bureau of Medicine and Surgery as defined by Navy Regulations (R 133) are given on page 291.

To carry out the duties enumerated a detail of officers and enlisted men of the Medical Department of the Navy will necessarily be found wherever the activities of the Navy lead.

The primary duty of the Medical Department of the Navy is to preserve the Navy's personnel—its fighting force—from sickness and injury; to reduce its impairment by reason of sickness or injury to the minimum; and to return men so incapacitated to active duty in the shortest period consistent with circumstances. To accomplish more readily this object naval hospitals have been established by the Bureau of Medicine and Surgery at the geographical points where concentration of naval activities occur. Officers and enlisted men, afloat or ashore, in need of hospital treatment are transferred to the naval hospital most convenient to the ship or station on which they are serving at the time.

Quite naturally it is here in our naval hospitals where the Medical Department's utility as a conserving force of the personnel of the Navy becomes most apparent, where its sphere of usefulness is best demonstrated, and where all that pertains to the sick and injured finds its greatest intensity and fullest development.

The naval hospitals controlled by the Bureau of Medicine and Surgery at present in commission number 18 and are located as follows: Portsmouth, N. H.; Chelsea, Mass.; Newport, R. I.; Brooklyn, N. Y.; Philadelphia, Pa.; Washington, D. C.; Annapolis, Md.; Norfolk, Va.; Port Royal, S. C.; Great Lakes, Ill.; Las Animas, Colo.; Mare Island, Cal.; Pearl Harbor, Hawaii; Puget Sound, Wash.; Guam; Yokohama, Japan; Canacao, P. I.; Olongapo, P. I.

The hospital at Las Animas, Colo., is for the treatment of tuberculosis patients only, and is situated in the southeastern part of Colorado, a region most favorable, on account of its climate, for the control of the disease.

Patients in the Navy may be admitted to an Army and Navy general hospital as prescribed by Navy Regulations (R 4531).

The Public Health Service hospitals and their contract stations are also available for treatment of the Navy's sick when a naval hospital is not convenient.

In an emergency a patient may be transferred to a civil hospital as prescribed in Navy Regulations (R 4532).

The insane of the Navy are all ultimately transferred to St. Elizabeth's Hospital, located in Washington, D. C., and under the control of the Interior Department.

Source and Application of Moneys Pertaining to the Bureau of Medicine and Surgery.

Since all moneys set apart for the Navy are placed for their expenditure under the cognizance of the several bureaus to which they pertain, one of the most important duties devolving upon the administrative head of the Bureau of Medicine and Surgery is the application of moneys coming under control of that bureau.

Moneys controlled by the Bureau of Medicine and Surgery are the means for the procurement of services, supplies, medicines, instruments, etc., for the Medical Department of the Navy on ships, stations, and at hospitals, and as such supplies and services may only be required by means of requisitions and vouchers it is very important that hospital corpsmen whose duty it becomes to prepare requisitions and vouchers for supplies, etc., in the Medical Department of the Navy have a clear comprehension of the source and applicability of moneys under cognizance of the bureau.

It should be made clear in this connection that while the Bureau of Medicine and Surgery has control over certain moneys for the purpose of defraying necessary expenses incident to the various duties with which it is charged, the actual disbursement of such moneys is not made by any officer connected with that bureau, but devolves, as does the disbursement of all moneys expended for the Navy, upon officers of the Pay Corps under the Bureau of Supplies and Accounts, and in some few instances upon the Auditor for the Navy Department.

Moneys controlled by the Bureau of Medicine and Surgery are received from two general sources, i. e., annual appropriations made by Congress, and the naval hospital fund.

Annual appropriations are made by Congress for the expenses during the fiscal year for which made—the fiscal year begins

July 1 and ends June 30. These appropriations are based upon careful estimates prepared by the several bureaus for the Secretary of the Navy, and transmitted by him to Congress through the Secretary of the Treasury.

The annual maintenance appropriations included in the naval appropriation bill that pertain to the Bureau of Medicine and Surgery are classified under the following fixed titles:

(1) Medical Department.

(2) Contingent, M. and S.

(3) Bringing home remains of officers, etc., Navy Department.

The detailed object of expenditures under these appropriations can best be made clear by quoting in full the phraseology of the several bureau appropriations taken from the naval act of August 29, 1916, making appropriations for the fiscal year 1917.

MEDICAL DEPARTMENT: For surgeons' necessaries for vessels in commission, navy yards, naval stations, Marine Corps, and for the civil establishment at the several naval hospitals, navy yards, naval medical supply depots, Naval Medical School, Washington, and Naval Academy, and toward the accumulation of a reserve supply of medical stores, $921,740.

CONTINGENT, BUREAU OF MEDICINE AND SURGERY: For tolls and ferriages; care, transportation, and burial of the dead; purchase of books and stationery, binding of medical records, unbound books, and pamphlets; hygienic and sanitary investigation and illustration; sanitary and hygienic instruction; purchase and repairs of nonpassenger-carrying wagons, automobile ambulances, and harness; purchase of and feed for horses and cows; purchase, maintenance, repair, and operation of two passenger-carrying motor vehicles for naval dispensary, Washington, District of Columbia, to be used only for official purposes; trees, plants, care of grounds, garden tools, and seeds; incidental articles for the Naval Medical School and naval dispensary, Washington; naval medical supply depots, sick quarters at Naval Academy and marine barracks; washing for medical department at Naval Medical School and naval dispensary, Washington; naval medical supply depots, sick quarters at Naval Academy and marine barracks, dispensaries at navy yards and naval sta-

tions, and ships; and for minor repairs on buildings and grounds of the United States Naval Medical School and naval medical supply depots; rent of rooms for naval dispensary, Washington, District of Columbia, not to exceed $1,200; for the care, maintenance, and treatment of the insane of the Navy and Marine Corps on the Pacific coast, including supernumeraries held for transfer to the Government Hospital for the Insane; for dental outfits and dental material, not to exceed $38,000, and all other necessary contingent expenses; in all, $241,080.

TRANSPORTATION OF REMAINS: To enable the Secretary of the Navy, in his discretion, to cause to be transferred to their homes the remains of officers and enlisted men of the Navy and Marine Corps who die or are killed in action ashore or afloat, and also to enable the Secretary of the Navy, in his discretion, to cause to be transported to their homes the remains of civilian employees who die outside of the continental limits of the United States, $24,908: *Provided*, That no deduction shall hereafter be made from the six months' gratuity pay allowed under the naval act of August twenty-second, nineteen hundred and twelve, on account of expenses for funeral, interment, or for expenses of preparation and transportation of the remains: *Provided further*, That the sum herein appropriated shall be available for payment for transportation of the remains of officers and men who have died while on duty at any time since April twenty-first, eighteen hundred and ninety-eight, and shall be available until June thirtieth, nineteen hundred and eighteen.

In all, Bureau of Medicine and Surgery, $1,187,728.

NAVAL HOSPITAL FUND.

This is not an appropriation made by Congress, and expenditures from this fund may be made only for expenses incurred in connection with naval hospitals and for the support of patients in civil hospitals at home and abroad.

Moneys held under this title, and the property and investments, including buildings and grounds purchased or otherwise acquired, constitute a trust fund of which the Secretary of the

Navy is the sole trustee. The moneys are deposited in the United States Treasury, and expenditures are safeguarded by the same laws, regulations, and procedures as govern the expenditures of appropriations that do belong to the United States Government.

The several sources of revenue of the fund are: (1) 20 cents per month "hospital tax," deducted from the pay of each officer, seaman, and marine, including members of the Navy Nurse Corps and Naval Auxiliary Service (sec. 4808, R. S.); (2) the value of one ration (30, 40, or 50 cents) per day during the period that each patient remains in the hospital (sec. 4812, R. S.); (3) the pensions of naval patients and supernumeraries while under treatment in hospitals (sec. 4813, R. S.); (4) all fines imposed by sentence of courts-martial (sec. 4809, R. S.); (5) all forfeitures on account of desertions (act approved June 7, 1900); (6) proceeds of sales of hospital property; (7) payments made by navy-yard employees for subsistence under authority of General Order No. 148, dated January 10, 1912, and Supplies and Accounts Memoranda for the Information of Officers, etc., No. 131, dated February 1, 1912.

For a history of the naval hospital fund see the Manual of the Medical Department of the Navy.

Organization of Bureau of Medicine and Surgery.

The following outline of the organization of the Bureau of Medicine and Surgery as at present conducted will make plain its several divisions and activities. With a knowledge of the duties of the other Navy Department bureaus heretofore enumerated, the reciprocal relations of the Bureau of Medicine and Surgery to these bureaus will be evident.

The Surgeon General of the Navy is chief of the Bureau of Medicine and Surgery and its administrative head. The assistant to bureau acts as executive, coordinating the entire organization and work of the bureau, under the supervision of the Surgeon General, and acts as chief of the bureau in the temporary absence of the Surgeon General. The chief clerk has general direction of bureau business, and in the absence of

both the Surgeon General and the assistant to bureau becomes the acting chief of bureau.

1. Division A (finance, general correspondence, etc.).
   Subdivision 1.
   (*a*) Finance.
   (*b*) Correspondence.
   (*c*) Clerical force.
   (*d*) Files.
   Subdivision 2. Pharmacist in charge.
   (*a*) Supplies.
   (*b*) Requisitions.
   (*c*) Public bills.
2. Division B (personnel). Medical officer in charge.
   Subdivision 1.
   (*a*) Medical Corps.
   (*b*) Medical Reserve Corps.
   (*c*) Dental Corps.
   (*d*) Dental Reserve Corps.
   (*e*) Red Cross.
   Subdivision 2. Medical officer in charge.
   Hospital Corps.
   Subdivision 3. Superintendent Nurse Corps in charge.
   Nurse Corps.
3. Division C (records and pensions). Medical officer in charge.
   Subdivision 1.
   (*a*) Physical qualifications of candidates for enlistment, appointment, promotion, etc.
   (*b*) Medical surveys.
   (*c*) Health records.
   Subdivision 2. Pharmacist in charge.
   (*a*) Pensions.
   (*b*) Records for promotion and retirement.
   (*c*) Reports and returns.
   (*d*) Vital statistics.
4. Division D. Medical officer in charge.
   (*a*) Construction.
   (*b*) Sanitary features, ships, and stations.
   (*c*) Legislation.

5. Division E (publications). Medical officer in charge.
   (*a*) Report of the Surgeon General.
   (*b*) Naval Medical Bulletin.
   (*c*) Miscellaneous.

CLERICAL WORK IN THE MEDICAL DEPARTMENT OF THE NAVY.

The clerical work in the Medical Department of the Navy required of the hospital corpsmen may be explained and studied most advantageously if separated into three divisions, viz, (1) general correspondence—i. e., letters, indorsements, etc.; (2) requisition and voucher forms for the procurement of supplies and services; (3) reports and returns other than requisition and voucher forms.

General Correspondence—i. e., Letters, indorsements, etc.

Official correspondence within the naval service is carried on in a manner prescribed in detail by Navy Regulations and Naval Instructions (ch. 44, I 5301, et seq.), and must in each instance conform to the instructions promulgated therein. While the substance of official correspondence concerning the Medical Department of the Navy is determined by the officers charged with such duty, its transcription in official form for signature and forwarding is quite usually intrusted to hospital corpsmen.

Most important of all for one intrusted with correspondence work is to keep a copy of every letter or indorsement prepared and to have a systematic method of numbering and filing all papers, so that they can be referred to readily.

A hospital corpsman detailed to perform this clerical work should of necessity have access to a copy of the Navy Regulations, and the instructions in chapter 44 thereof should be referred to whenever there is any doubt as to the proper form to be used or method of procedure to be followed, the intention here being to extract only so much of the official instructions as will make clear the essential features of service correspondence by letter and indorsements.

EXTRACTS FROM NAVY REGULATIONS BEARING ON OFFICIAL CORRESPONDENCE.

I 5352. All officers shall file and preserve all official documents received and copies of all official letters and indorsements sent. Suitable files containing copies of all orders given and official letters written, and the original of all letters received on public service in all offices on board naval vessels and at shore stations shall be kept and preserved. Commanding officers may take copies of orders or letters sent or received. The system of filing shall be such as to safeguard all official papers and to render them readily accessible for reference. A flat-filing system shall be used when practicable.

I 5310. Officers commanding fleets, squadrons, or stations, and other officers having a regular correspondence with the Navy Department shall number their letters.

All correspondence shall be typewritten if practicable, but should a typewriter be unavailable the communication must be legibly written without erasures or interlineations.

Record (noncopying) typewriter ribbons shall be used.

Letters and indorsements shall not be press copied, but a sufficient number of carbon copies shall be made in lieu thereof for the files or other purposes. The name of the signing officer shall be stamped or otherwise placed on all copies.

I 5311. For official correspondence in the Navy, whether letters or indorsements, letter paper shall habitually be used. For the original or first copy it shall be white linen typewriter paper 8 by 10½ inches in size, weighing approximately 4½ pounds per ream of 500 sheets of that size. For file copies a green-tinted paper of the same size and weighing 3 pounds per ream shall be used. For additional carbon copies thin paper other than green shall be used.

Typewriter cap, used only in special cases, shall be 8 by 13 inches in size, but otherwise similar to letter paper.

Paper for letters and indorsements shall have two holes punched in it, the centers of the holes to be one-half inch from the top of the sheet and 2¾ inches apart and equidistant from

the center of the sheet in order that the sheets may be uniformly fastened together. The holes shall not exceed three-sixteenth inch in diameter.

I 5312. The forms prescribed in this article shall apply to all correspondence within the naval service, with the State naval militia organizations, and with such department as may adopt a similar form of correspondence, but not with departments, officials, and persons that have not adopted these or similar forms.

Letters shall begin with the ship or station, place, and date. The upper line of the heading shall be about 1½ inches from the top of the page.

The official designation of all vessels of the Navy shall be the name of the vessel preceded by the letters "U. S. S." The word "flagship" shall follow the name of the vessel in the heading of a communication emanating from the office of a flag officer.

In communications dated on board a vessel at sea the latitude and longitude shall be stated if exactness be necessary; otherwise the expression "Passage__________ to__________" shall be used.

Following the heading and date in letters and indorsements the official designation, or having no other official designation than title, the name and rank of the writer, preceded by the word "From," shall be written at the left side of the page. "From" shall not be used when the letterhead indicates the writer.

On the line below "From," if used, otherwise in place of it and preceded by "To" at the left of the page shall appear the official designation of the office or official addressed; following this the channel through which the communication is to pass.

Following the address the subject of the correspondence, briefed, shall be written across the page preceded by "Subject."

The brief of the subject should be written in about the same form and terms as would be used in indexing the communication in filing. For example: "*Delaware*; feed pumps; recom-

mends change in type." "Navy Yard, New York; dry dock *No. 1;* reports damage to caisson struck by tug."

The subject shall not be repeated at the beginning of an indorsement except when required by the filing system of the writer's office to identify the file copy or when the indorsement begins on a new sheet.

After the subject the references to previous correspondence on the same subject, if any, shall be briefly indicated, preceded by "Reference."

In acknowledging, answering, or referring to official communications the file number (letters as well as figures) and date shall be included in the "Reference." References shall be lettered in small letters, and may be referred to in the communications as "Reference (a)," etc.

When a plan that has been given a file number is referred to in the correspondence this number should be stated in connection with such reference.

Following "Reference," if any, the number of inclosures shall be stated, preceded by "Inclosure," at the left of the page.

Where necessary, the method of forwarding, whether inclosed, under separate cover, or by express, shall be indicated. The absence of "Reference" or "Inclosure" will indicate that no reference or inclosure accompanies the communication.

The file number of the letter or indorsement shall be placed in the upper right corner, about 1 inch from top and 1 inch from the right edge of the page. The abbreviation or initials of the section or division in which the correspondence is prepared shall appear.

The body of letters and indorsements shall be written single spaced, with one double space between paragraphs. Each indorsement shall, where possible, be written on the same sheet as the preceding letter or indorsement, with a space of about one-half inch intervening. A line, or line of dashes, shall be drawn across the sheet below the letter and each indorsement, leaving a three-fourths inch space between this line and the last line of writing for the signature.

Paragraphs in letters and indorsements, or other official papers, shall be numbered. Subparagraphs shall be lettered, thus: (a), (b), etc. The lettering of subparagraphs shall run consecutively irrespective of the paragraphs. Thus, if the first paragraph contains subparagraphs (a) and (b), subparagraphs in the second paragraph should be lettered (c), (d), etc.

The body of the letter shall begin and end without any ceremonial form or expression, such as "Sir," "I have the honor to report," "Very respectfully," etc., and shall be followed by the signature of the writer without designation of rank, title, or office. Information will be imparted, reports made, and questions asked directly, dispensing with such introductory phrases as "The bureau informs you that," "Information is requested as to," "It is directed," etc. With the exception of "M. C.," to distinguish members of the Marine Corps, such words and initials as "U. S. Navy," "U. S. S.," "U. S. N.," shall not be used in the body of the letter. "Bureau of Ordnance" and "Navy Department (Operations)" shall be used instead of "Chief of Bureau of Ordnance," "Navy Department (Chief of Naval Operations)."

When any article referred to in a communication is forwarded under separate cover, it shall be tagged and plainly marked in the following manner: "From Commanding Officer, U. S. S. ----, accompanying letter (or indorsement) No. ------, date ------." If possible this shall appear also on the box or package carrying the inclosure.

Stamps showing the date of receipt of papers shall be so placed as not to occupy any writing space. If stamps constituting *pro forma* indorsements, such as "Received and forwarded," "Referred for action," etc., are used, they will be placed on the face of pages as though written in a more formal manner, and will be numbered.

Indorsements, whether written or stamped, except those referred to in the next paragraph, shall be placed in regular order, beginning on the last page of the letter, immediately below the signature, if there be room there; if not, additional full-sized sheets shall be appended to the letter to accommodate

them. Indorsement slips shall not be used, except on correspondence with other departments using such slips.

All indorsements affecting pay, mileage, transportation, and traveling expenses shall be placed on the face of the original order involving travel, if practicable; otherwise on the back of the order. Such indorsements shall never be placed on sheets which might be detached from the original order.

Only one side of the sheet shall be written upon, and a margin of ¾ inch shall be left on each side and at the bottom of the sheet.

I 5313. The sheets of a letter or report shall be arranged in regular order from bottom to top; i. e., the first sheet on the bottom, the last sheet on top. Inclosures, if any, shall be attached in regular order on bottom of the letter, all securely fastened together, the head of the fastener underneath and the ends turned over the face of the correspondence, in order that the last sheet may be readily removed to place indorsements thereon. Additional sheets bearing indorsements shall be attached, each on top of the preceding one, on the face of the correspondence, so that the last indorsement shall be uppermost. Whenever an indorsement begins on a new sheet, the subject shall be repeated. Each page of letters and indorsements shall be numbered in the middle of the page, about ½ inch from the bottom. These numbers shall run consecutively throughout the correspondence.

When folding is necessary, letter paper shall be folded in three and typewriter cap in four equal folds parallel to the writing.

I 5322. In general, all communications shall be addressed to those who, by regulation or law, have cognizance of the subject presented or are authorized to take action thereon.

All official communications intended for officers holding positions with recognized titles shall be addressed to them by title and not by name, as "The Secretary of the Navy," "Bureau of Navigation," "The Commandant," "The Commander in Chief ——— Fleet (or Squadron)," "The Commander, ——— Squadron (or Division)," "The Commanding Officer."

An officer left in temporary command of a station, fleet, squadron, or division, or, in general, of any command, shall be addressed as if he were the regular commanding officer, on the principle that it is the office and not the person that is addressed. The temporary incumbent shall so transact the business that necessary copies shall be preserved in the files of the absent superior officer's office, using the stationery of that office when practicable.

Except from ships in commission, communications relating solely to subjects with which a bureau is intrusted shall be addressed to the chief of that bureau.

I 5307. As a general rule, a letter shall be answered by a separate letter and not by indorsement. This regulation is not intended to prevent the use of stamped or written indorsements on papers or reports of which copies are not retained, or to prevent the use of indorsements on papers necessarily referred to several bureaus or offices; it is intended to prevent the practice of having an original letter returned to the writer by an indorsement containing the report or information requested, and having in the indorsement a request for the return of the papers to the office or person to which they were originally sent, as such procedure necessitates increased clerical work in copying the indorsement and requires the papers to be mailed three times. When the original is answered by a separate letter each office has a complete record of the correspondence without extra work, and the papers are sent through the mails twice instead of three times.

Separate letters shall be written on separate subjects unless the subjects are of like nature.

All communications, except such as require neither action nor reply, shall be acknowledged.

I 5308. Communications received by a bureau or office containing information, a knowledge of which is necessary or would be useful to the department, or any other bureau or office, shall be promptly referred accordingly, or copies thereof shall be furnished.

Examples of the forms of correspondence described above may be seen by referring to I 5312, Navy Regulations and Naval Instructions.

Requisition and Voucher Forms.

When the procurement of supplies in the Medical Department of the Navy becomes necessary the first step is to determine the source from which the supplies are to come; that is, are they such as are carried in stock or can most conveniently be furnished by a naval medical supply depot, are they kept in store for issue by a general storekeeper, or will it be necessary to purchase them in the open market. In the procurance of supplies from any of these sources a requisition is required, and the source decides the proper form of requisition to submit. The several requisition forms in use by the Medical Department of the Navy may therefore be classed as follows:

1. Supply Depot
   - Form B.
   - Form B—dental.
   - Form Ba.
   - Form 4.
2. Open purchase
   - Medicine and Surgery Form No. 1 (supplies and services, shore stations).
   - Supplies and Accounts Form No. 44 (supplies and services afloat).
3. General storekeeper—Stub requisition—Supplies and Accounts forms, ashore and afloat.

It should be stated that the Bureau of Medicine and Surgery has established naval medical supply depots at Brooklyn, N. Y., Mare Island, Cal., and Canacao, P. I., where most of the medical supplies used in the Navy are purchased in large quantities for the depots by the Bureau of Supplies and Accounts on requisitions submitted by the depots and approved in the usual way by the Bureau of Medicine and Surgery. These supplies are stored for issue from time to time upon approved requisitions to the medical departments of the several ships and stations.

An open-purchase requisition, as the name indicates, is one under which the supplies are to be purchased in the open mar-

ket after competition. Certain classes of medical supplies are exempt by law from *newspaper* advertisement, but none may be purchased except by the proper representative of the Bureau of Supplies and Accounts after competition between two or more dealers by means of proposals or bids, and all purchases and payments are made by that bureau.

Any stores carried in stock by a general storekeeper for issue in the service may be procured on stub requisitions (S. and A. forms) prepared and submitted by the head of the department concerned.

All requisitions concerning the medical department of a ship, hospital, or other shore station, except stub requisitions, are numbered consecutively throughout the fiscal year, which begins on July 1 and ends on June 30 of the following year. On June 30 of each year, therefore, the series for that fiscal year becomes complete, and the first requisition after that begins again with No. 1 of the new fiscal year. Duplication of requisition numbers in one fiscal year, a common occurrence, should be scrupulously avoided. This causes confusion both in the bureau and in other offices handling the requisitions, and complicates any correspondence that may become necessary in connection with such requisitions. This duplication is an evidence of inexcusable carelessness in the clerical department concerned.

REQUISITIONS FOR STORES FROM A SUPPLY DEPOT.

A supply table and field supply table of the Medical Department of the Navy are issued by the bureau and are intended as a basis for requisitions for stores from supply depots. They contain a printed list, arranged alphabetically and by classes, of supplies kept on hand for issue, with allowances for quantities based on the complement of men on a ship or station. The field supply table contains a list of all articles necessary for the equipment of a field hospital, regimental hospital, battalion, and company. This field supply table is to be inserted and securely fastened to the supply table.

Every office where requisitions of the Medical Department are prepared should have a copy of the supply table (with the field supply table inserted) on file.

Full instructions for preparing requisitions for stores to be drawn from a supply depot are printed on the several forms, and these instructions must be followed in each instance.

A brief description only of these requisition forms is here necessary.

Form B contains a printed list of the medical supplies as given in the supply table, and is intended for use when a large number of the articles is required.

Form B–dental contains a printed list of dental supplies listed in the supply table, and is intended for use of dental officers only.

Form 4 is a blank form to be used when a limited number of articles listed on Form B is required; also for indispensable articles not on Form B which can most conveniently be furnished by a supply depot. Separate requisitions must, however, be prepared in each instance for articles listed on Form B and for articles not listed on Form B. The latter requirement is important and should be strictly adhered to, for the reason that supply-depot accounts are kept in accordance with this classification. When a Form 4 requisition is submitted for articles not on the supply table a letter of explanation as to their necessity should accompany the same.

Form Ba is a special requisition form embracing a supplementary list of articles (on charge but not included in the supply table) in store at the naval medical supply depot.

These four separate forms, B, B–dental, Ba, and 4, are all prepared in quadruplicate (and retained copy), giving the number of the requisition, and marked "First," "Second," "Third," "Fourth." They should be forwarded for approval as directed on the forms. It should be evident that no money values are to be entered by the maker on the face of any supply-depot requisition, since the stores are purchased in the open market on requisition for the supply depot and their issue value determined in that way. When priced in the depot the first and

second are returned to the maker of the requisition as priced invoices, and he is to enter the values on the third. After receipt of the stores the forms are signed by the receiving officer, and they then become vouchers. The first is returned to the supply depot, the second to the bureau, and the third is retained for the files of the ship or station. The fourth, retained in the bureau on approval of the requisition, is destroyed when the receipted second has been received and filed.

A supply depot must necessarily have some authority and a system of accountability for making expenditures from their stock. The first of every approved requisition is, then, not only a depot's authority for the issue of the stores enumerated thereon, but becomes, when receipted, a voucher in the depot's system of accounting for the expenditure of their stock. It should be plain, therefore, that no stores may be issued from a supply depot except upon an approved requisition, and in every instance requests for such supplies should be submitted for approval on the proper Medicine and Surgery requisition forms and not by letter.

REQUISITIONS FOR OPEN PURCHASE.

Medicine and Surgery requisition Form 1 is used for all purchases of supplies and services on shore for the Medical Department of the Navy.

Supplies and Accounts requisition Form 44 is used by the Medical Department of the Navy for all purchases of supplies and services afloat.

Blank forms are used that indicate the information required concerning the necessity and character of and quantity and estimated cost of the supplies or services to be purchased.

Each requisition is accompanied by so many memorandum copies as may be required. The estimated cost of each item and the total is entered upon the memorandum copies only. The original bears signatures, and, except in the cases of formal contracts, accompanies the original of the public bill, and finally lodges with the accounting officer (auditor) of the Treasury. One memorandum copy of the requisition remains

in the Bureau of Medicine and Surgery, two in the Bureau of Supplies and Accounts, and one in the office of the purchasing pay officer.

Requisitions must give such accurate information as will enable the purchasing pay officers and the bidders readily to understand what is required, and items must be arranged so that articles of a similar nature may be grouped. Articles or services coming under different appropriations may not be combined on one requisition. Proprietary articles must not be called for when it can possibly be avoided, but when called for the officer making the requisition must certify that "the article and no other will answer the necessities of the service."

A hospital corpsman preparing requisitions for open purchase should be familiar with section 3, chapter 39, Naval Instructions, and the instructions contained therein must be carefully followed.

Copies of all instructions issued from time to time by the Bureau of Supplies and Accounts relative to the preparation of open-purchase requisitions should be filed, so that ready reference thereto may be made.

Particular attention should be given the question of procuring materials under standard specifications, and requisitions should adhere strictly to such specifications.

SUPPLIES FROM GENERAL STOREKEEPERS ON STUB REQUISITION.

Stub requisitions on a general storekeeper ashore or afloat are prepared by the head of the medical department on the prescribed forms (S. & A.) and do not require the approval of the Bureau of Medicine and Surgery. For the latter reason and the further fact that this arrangement is local, stub requisitions are not numbered in the regular series of the fiscal year. They should, however, be numbered consecutively by fiscal years in a series of their own, and duly filed as vouchers when the transaction has been completed.

Whenever practicable, advantage should be taken of this means of securing needed supplies that are carried in stock by

a general storekeeper. These supplies are purchased in large lots at a reduced cost; they are standard goods and their quality can be depended upon. Furthermore, this method of procural is direct and so avoids the delay consequent upon the bureau's approval of a more formal requisition and the purchase and delivery of supplies thereunder.

PUBLIC BILLS.

When supplies purchased under an open purchase requisition have been received and accepted, the next step is the preparation of a public bill for their payment.

Public bills are prepared on blank forms furnished for the purpose. Medicine and Surgery bill Form 5 is used with requisition Form 1; Supplies and Accounts bill Form 51a is used with requisition Form 44. These blank forms have been previously submitted to the Comptroller of the Treasury, whose approval of same as to completeness is required by law before they may be used. An original and a sufficient number of memorandum copies are required. The original, accompanied by the original of the requisition, finally lodges with the auditor. One memorandum copy remains in the Bureau of Medicine and Surgery, two in the Bureau of Supplies and Accounts, one with the pay officer who makes the payment, one with the accounting officer of the yard, and one, stamped "Dealer's copy," accompanies the check to the payee as an identification of the payment. The office in which the requisition and public bill originate of course retains copies of each, which are recorded in the bill book. Signatures are only affixed upon the original copy of a public bill. The memorandum copies are true copies, except that the places for signatures are filled by stamping or typing therein the names.

All articles on a requisition may not be procured from one dealer, in which case two or more public bills may be necessary in connection with but one requisition; in such instances the original of the requisition accompanies the first public bill made, and notation of the disposition is appropriately made on all subsequent public bills under the requisition.

Medical officers are responsible for the correctness of the certificate of inspection and acceptance, and the purchasing pay officers for the correctness of the certificate as to method of purchase and as to prices. It is expected of both that they exercise special care not only as to accuracy of figures, but also that the appropriation involved shall be correctly stated in title and fiscal year.

The requisition and voucher forms have been carefully prepared to meet every legal requirement, and it is forbidden that the phraseology of the forms should be altered when either supplies or services are furnished or performed.

SPECIAL EXIGENCY VOUCHER.

Medicine and Surgery Bill Form 6 (on shore only). This voucher form is for use at hospitals and at shore stations in cases of sudden emergency, such as broken water, steam, or gas pipes; falling walls or ceilings; broken heating or cooking apparatus; and in all cases where the work must be done immediately; also for the immediate purchase of articles not provided for on approved requisitions for the care and welfare of the sick. It shall never be used if time will allow the procurement of the articles or services on an approved requisition. The exigency clause on Bill Form 6 is certified to by the senior medical officer of the hospital or station, after which it is forwarded to the Surgeon General for approval, and subsequently transmitted to the Bureau of Supplies and Accounts for action prescribed for other public bills.

SPECIAL SUPPLIES AND METHOD OF PROCURAL.

Vaccine is procurable upon application by letter or telegram to the Bureau of Medicine and Surgery. On the Pacific coast, from the supply depot, Mare Island.

Antityphoid prophylactic, serums, etc., are procurable by letter or telegram to the Bureau of Medicine and Surgery.

Tubes, culture medium, are procurable upon application by letter or telegram to the United States Naval Medical School, Washington, D. C.

Microscopical outfits are furnished by the Naval Medical School, Washington, D. C.; should be required for on Form 4, the requisition to contain this item and no other.

Blood stain in sealed tubes containing 0.075 gm., with methyl alcohol 25 mils, is procured from the Naval Medical School by letter or telegram.

Alcohol is procured from the general storekeepers ashore and afloat, in quantities of not less than 5 gallons ashore and 1 gallon afloat.

Transfer of labor from Navy yard.—S. & A. form required; direct request upon head of department; approval of commandant.

Supplies under Navy pay office contracts.—Medical officer in command makes order upon contractor.

ARTICLES SUPPLIED ON ANNUAL CONTRACT OF THE BUREAU OF YARDS AND DOCKS.

When it becomes necessary to prepare a requisition at a naval hospital or shore station for furniture, etc., the contract schedule covering annual contracts entered into by the Bureau of Yards and Docks, copy of which may be found in the office of the public works officer of the station, should be examined to ascertain whether items supplied under the annual contract will not fulfill requirements.

Articles desired under such contract should appear on a separate requisition prepared in the usual way on Form 1, and, in making selections from the contract, the following information should be given in every instance on the face of the requisition and in the order here indicated:

(*a*) Item number of contract.
(*b*) Name of article required.
(*c*) Pattern number of article required.
(*d*) Kind of wood of article required.
(*e*) Upholstering number when applicable.

This information is necessary to make clear to the Bureau of Yards and Docks what is desired when placing the order with the contractor.

The contractor is directed by the Bureau of Yards and Docks to ship the articles to the hospital or medical department of the station concerned. If inspection of the articles proves satisfactory, preparation of the necessary voucher or vouchers for payment of the stores is made by the medical department on the prescribed bill form and in the usual way.

DEPARTMENTAL CONTRACTS.

When a formal departmental contract is entered into by the Government for material or services for the Medical Department of the Navy and the work is carried on under supervision of the Bureau of Yards and Docks, vouchers for payment of bills under the contract are prepared by the public works officer having direct supervision of the work, and copies of all vouchers to complete the files of the medical department of the station concerned should be procured from the office preparing the vouchers.

It is very important that a full set of vouchers for each contract be recorded and filed, so that a complete record of the cost, date of completion, etc., of work will show on the bill book.

Blank Forms and Returns of the Medical Department of the Navy, Other Than Requisition and Voucher Forms.

With the object of securing uniformity and accuracy of the reports and returns connected with the duties of the Medical Department of the Navy certain blank forms have been established, and the specific purposes designated for which such forms shall be used. The data contained in these reports are the basis for all of the bureau's statistical compilations, and further, these reports become permanent and highly important records upon which the bureau is compelled to rely for the medical histories of the officers and enlisted men of the Navy when furnishing specific information of importance demanded by other departmental bureaus and of vital concern to the individual. It should therefore be obvious that these reports must be without error; furthermore, in combining and tabulating

these reports an error in any one makes the whole faulty and impairs any deductions made from such statistics.

To further the uniformity and accuracy desired and to aid those preparing these forms detailed instructions for preparing each particular form is printed on the form itself, or the information desired is fully indicated in the printing and wording on the form. The great difficulty with printed instructions of this character is to have the men for whose guidance they are intended read them and then comply strictly with the directions given. This is most important, for only in this way can mistakes and the needless correspondence entailed thereby be eliminated and a repetition or correction of the work be avoided.

Before attempting, then, to prepare any bureau form or report it becomes necessary to read carefully the instructions pertaining to the form and to understand their meaning.

These forms, as well as the instructions for preparing them, are subject to change, so that the form itself should be resorted to for the necessary directions in its preparation.

In the table of the forms given, beginning on page 333, they are arranged in groups, according to the time when each form is to be submitted, i. e., weekly, monthly, quarterly, annually, etc., with additional columns to make clear their handling in general. Forms peculiar to a few stations and those whose use is limited have been omitted; their acquaintance may well be delayed until such time as their preparation becomes necessary by the individual.

IDENTIFICATION RECORD.

This record consists of finger prints and personal description, and is to be forwarded to the Bureau of Navigation in the case of every man enlisting in the Navy and to the major general commandant in the case of marines. The finger-print and identification record is not required upon reenlistment or upon discharge for undesirability. The form adopted for recording of finger prints and personal description (Form No. 2, Bureau of Navigation), (in the case of marines Form N. M. C. 330),

(Naval Instructions 5249 (6) ; 5261 (7)), will carry the finger-print record on one side and the personal description on the other.

INSTRUCTIONS FOR THE GUIDANCE OF THOSE CONCERNED IN MAKING AND FORWARDING OF IDENTIFICATION RECORDS.—It is absolutely necessary that the finger prints shall be clear, that the ridges be distinctly molded and outlined and free from blur,

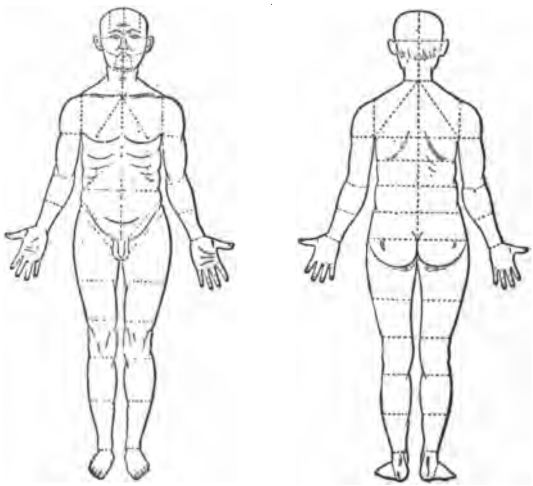

FIG. 100.—Outline figure card.

and the "rolled" impressions be sufficiently large to include all points necessary for accurate classification.

The apparatus consists of a form holder, ink plate, ink, and roller.

The roller and the ink plate must be kept clean and free from dust, grit, or hairs. For cleaning after the day's work is finished use a soft cloth and benzin.

The ink for the plate must be spread in an even film before attempting to take the finger prints. Too much ink on the plate will cause the print to be blurred.

Care should be taken to see that the fingers of the recruit are clean and dry before attempting to make impressions of them.

In taking the impressions the operator should manipulate the hands of the recruit, who should be instructed to relax his fingers and not to attempt to assist by adding pressure on the inked plate or on the paper. In order that the ink may be taken up on the finger evenly and in sufficient quantity, an unused part of the plate should be selected each time for inking the finger, and when no unused part of the plate can be found readily the plate should be reinked.

The form holder is used for keeping the paper from moving about and blurring the print.

After the finger prints have been taken and examined the opposite side of the form shall be filled out. Then the recruit will be required to sign his name, after which a rolled impression of the index finger of the right hand is taken in the place reserved for the purpose. Allow the form to dry a little and then make out the personal description. The following abbreviations are authorized and will be understood in the sense indicated: Amp., amputation; bl., blue; bmk., birthmark; bro., brown; d., depressed (except following a dimension, when it stands for diameter); f., flat; fl., fleshy; h., hairy; m., mole; p., pitted; p. m., pinhead mole; r., raised; s., scar; v., vaccination; var., varicose veins or varicocele; w., wart; all combinations of the above abbreviations are acceptable; for example, p. s. ½ d. would indicate that a pitted scar one-half inch in diameter could be found on the recruit.

Tattoo marks should be noted and described in detail as they appear. In the case of devices containing two or more figures the component parts should be named; for example, "heart, cross, and anchor," not "faith, hope, and charity"; "clasped hands," not "friendship."

An identification card that shows five or less marks is of little use for identification; experience shows that 10 to 15 marks may usually be found.

ERRORS AND OMISSIONS IN THE HEALTH RECORDS OF OFFICERS AND ENLISTED MEN.

Rank or rating frequently omitted or not correctly given on cover.

Data not given in full on the first and second pages.

Promotion of officer or termination of service of enlisted man often omitted on the page for that purpose.

Number of enlistment not marked.

Name of patient and place not given on each sheet of medical history.

Name of man omitted from abstract.

Initialed and unsigned abstracts.

Abstracts often show no date of attachment or detachment.

In case of reenlistment immediately the abstract is often not detached from the old record and placed in the new one.

Typhoid prophylaxis and vaccination records are often incomplete.

Abbreviation of ranks, grades, and ratings.

Admiral	Admr.
Vice admiral	VAd.
Rear admiral	RAd.
Captain (U. S. N.)	Capt.
Commander	Comdr.
Lieutenant commander	Lt–C.
Lieutenant	Lt.
Lieutenant (junior grade)	Lt–jg.
Ensign	Ens.
Midshipman	Mid–1, Mid–2, etc.
Medical director	MDir.
Medical inspector	MIns.

Surgeon	Surg.
Passed assistant surgeon	PAS.
Assistant surgeon	ASurg.
Acting assistant surgeon	AAS.
Dental surgeon	DentS.
Pay director	PDir.
Pay inspector	PIns.
Paymaster	Pay.
Past assistant paymaster	PAP.
Assistant paymaster	APay.
Chaplain	Chap.
Professor of mathematics	PMath.
Naval constructor	NCon.
Assistant naval constructor	ANCon.
Civil engineer	CEng.
Assistant civil engineer	ACEng.
Boatswain	CBoat. or Boat.
Gunner	CGun. or Gun.
Machinist	CMach. or Mach.
Carpenter	CCarp. or Carp.
Sailmaker	CSail. or Sail.
Pharmacist	CPharm. or Pharm.
Pay clerk	CPayC. or PayC.
Major general commandant	MGComM.
Brigadier general	BrGM.
Colonel	ColM.
Lieutenant colonel	LtCM.
Major	MajM.
Captain (U. S. M. C.)	CapM.
First lieutenant	1–LtM.
Second lieutenant	2–LtM.
Quartermaster's clerk	QrCM.
Marine gunner	MarG.

SEAMAN BRANCH.

Master at arms	CMatA, MatA–1, MatA–2, MatA–3.
Boatswain's mate	CBM, BM–1, BM–2.

Gunner's mate	CGM, GM-1, GM-2, GM-3.
Turret captain	CTC, TC-1.
Quartermaster	CQr, Qr-1, Qr-2, Qr-3.
Coxswain	Cox.
Seaman gunner	SeaG.
Seaman	Sea-1, Sea-2.
Apprentice seaman	AS.

ARTIFICER BRANCH.

Machinist's mate	CMM, MM-1, MM-2.
Electrician	CEL, El-1, El-2, El-3.
Carpenter's mate	CCM, CM-1, CM-2, CM-3.
Water tender	CWT, WT.
Boilermaker	Bmkr.
Coppersmith	Csmth.
Shipfitter	Sfit-1, Sfit-2.
Blacksmith	Blks.
Plumber and fitter	P&F.
Sailmaker's mate	SmM.
Painter	Ptr-1, Ptr-2, Ptr-3.
Oiler	Oiler.
Printer	CPrint, Print-1, Print-2.
Fireman	F-1, F-2, F-3.
Shipwright	Swrt.
Storekeeper	CStr, Str-1, Str-2, Str-3.

SPECIAL BRANCH.

Yeoman	CY, Y-1, Y-2, Y-3.
Pharmacist's mate	CPhM, PhM-1, PhM-2, PhM-3.
Bandmaster	Band.
Commissary steward	CCmS, CmS.
First musician	1 Mus.
Ship's cook	SC-1, SC-2, SC-3, SC-4.
Baker	Bak-1, Bak-2.
Hospital apprentice	HA-1, HA-2.

Musician	Mus–1, Mus–2.
Bugler	Bugler.
Landsman	Lds.

MESSMAN BRANCH.

Steward to commander in chief	SCinC.
Cook to commander in chief	CCinC.
Steward to commandant	SCom.
Cook to commandant	CCom.
Cabin steward	CabS.
Cabin cook	CabC.
Wardroom steward	WRS.
Wardroom cook	WRC.
Steerage steward	StS.
Steerage cook	StC.
Warrant officers' steward	WOS.
Warrant officers' cook	WOC.
Mess attendant	MsA–1, MsA–2, MsA–3.

MARINE CORPS.

Sergeant	Sergt.
Corporal	Corp.
Private	Pvt.
Apprentice marine	ApM.
Drummer	Drum.
Trumpeter	Trump.

PRISONERS.

Men serving a sentence under a general court-martial (not those awaiting trial) should be noted as "GCMP," or for detentioners "Det–1," etc., in spaces provided for ratings.

Blank forms of the Medical Department of the Navy other than requisition and voucher forms.

Name of report.	Form number, etc.	No. of copies.	To whom sent.	Remarks.
Daily.				
1. Morning report of sick.	Special M. & S.	1	Commanding officer.	Made after sick call.
2. Binnacle list........	Special M. & S.	1	Officer of deck..	Do.
Weekly.				
3. Memorandum of Hospital Corps.	Special form.	1	Bureau M. & S..	Forwarded Saturdays.
4. Report of sick......	I..........	2	Bureau and commandant.	Do.
5. Pay roll............	S. & A. 84.	1	Pay officer......	For civil employees. Monthly summary to Bureau M. & S.
Monthly.				
6. Summary of pay roll.	S. & A. 184.	2	.....do...........	Civil employees.
7. Recapitulation of pay roll.	S. & A. 184a	1	.....do...........	Do.
8 Estimate of funds.	S. & A. 144.	1	.....do...........	Not later than 3d of month.
9. Return of nurses..	115148-7...	1	Bureau M. & S..	Nurse Corps form.
10. Sanitary report....	Letter.....	1	To commandant.	
Quarterly.				
11. Abstract of patients.	F.........	1	Bureau M. & S..	Also when out of commission.
12. Statistical report...	K.........	1	.....do...........	Do.
13. Subsistence report Hospital Corps.	88051......	2	.....do...........	For auditor.
14. Return of medical stores.	V.........	1	.....do...........	Supply depots only.
15. Recruiting statistics.	X.........	1	.....do...........	Prepared from rough X.
Annually.				
16. Sanitary report....	Letter.....	1	.....do...........	Jan. 1 and when out of commission.
17. Report of operations.	P.........	1	.....do...........	Do.
18. Inventory of property.	D. & Da..	1	.....do...........	June 30.
19. Statement of cost of maintenance.	125345.....	2	.....do...........	Made up from bill book.

Blank forms of the Medical Department of the Navy other than requisition and voucher forms—Continued.

Name of report.	Form number, etc.	No. of copies.	To whom sent.	Remarks.
Annually.				
20. Application for headstones.	126221	2	Bureau M. & S.	For unmarked graves in naval cemeteries.
21. Medical history (officers).	H-green	All loose sheets.	do	Except in the case of midshipmen, when they will be retained until termination of service as such.
22. Recruiting statistics.	X	1	do	From rough X.
When necessary.				
23. Survey of property.	C	2	do	Supply depots only.
24. Survey of property.	Ca	2	do	
25. Hospital ticket	G	1	To hospital	R-2961.
26. Abstract of patients.	Rough F	2	Bureau M. & S. and retain in files.	
27. Health record	H-gray	1	Bureau M. & S.	Upon termination of enlistment or promotion to officer, I-2117.
28. Health record	H-green	1	do	Upon termination of active service, I-5222 (5q).
29. Casualty report	K_2	2	Bureau M. & S. and fleet surgeon.	After an engagement and after any unusual casualty.
30. Request for survey.	L	1	Senior officer present.	R-2960.
31. Report of survey	M	2	Bureau M. & S.	Additional copy to fleet surgeon, if in squadron.
32. Report of death	N	2	do	3 copies required in case of officer, R-2963, I-5247 (36).
33. Request for blank forms.	O	1	Supply depot	
34. Clinical chart	Q	1	Retain for files	
35. Eff. report H. C.	Nav. form 238.	1	Bureau M. & S.	I-5222 (5y).
36. Change in H. C.	125682	1	do	Post card.
37. Exam. report H. C.	37481	2	Bureau M. & S. and C. O. having accounts.	R-3551 (7).
38. Transfer of patients to other than naval hospital.	Letter	2	Bureau M. & S. and fleet surgeon.	R-2962, R-3582. R-4532-34.

Blank forms of the Medical Department of the Navy other than requisition and voucher forms—Continued.

Name of report.	Form number, etc.	No. of copies.	To whom sent.	Remarks.
When necessary—Con.				
39. Report of epidemics.	Letter.....	2	Bureau M. & S. and fleet surgeon.	
40. Journal of Med. Dept.	Book......	1	Bureau M. & S..	When out of commission.
41. Ration notice (admission).	S..........	1	Pay officer. When Nav. Aux. Service, to master of ship.	
42. Ration notice (discharge).	T.........	1	.....do..........	
43. Retention or admission of supernumeraries.	Letter.....	1	Bureau M. & S..	
44. Transfer of stores...	D. & Da..	3	Bureau M. & S., receiving officer, transferring officer.	
45. Sanitary conditions and suggestions.	Letter.....	1	Commanding officer of ship.	R-2953, R-2954.
46. Admission and discharge of officer.	Letter.....	1	To comdt.......	
47. Burial records.....	Book......	....	Bureau M. & S..	When hospital is put out of commission.
48. Ambulance book...	Book......	....	.....do..........	Do.
49. Register of patients	Book......	....	.....do..........	Do.
50. Bill book and commissary ledger.	Books.....	....	.....do..........	Do.
51. Statement of qualifications for chief pharmacist's mate.	Letter.....	1	.....do..........	
52. Misconduct report (admission).	126920-1...	3	C. O., pay off., enlistment rec.	For disease the result of own intemperate use of drugs or alcoholic liquors or other misconduct.
53. Misconduct report (discharge).	126920-1...	3	.....do..........	Do.

Ships: 1, 2, 11, 12, 16, 17, 18, 21, 22, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 44, 45, 51, 52, 53.

Hospitals: 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 16, 17, 18, 19, 20, 21, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, 43, 44, 46, 47, 48, 49, 50, 51, 52, 53.

Navy yards and stations: 1, 5, 6, 7, 10, 11, 12, 16, 17, 18, 21, 22, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 44, 51, 52, 53.

Training stations: 1, 3, 10, 11, 12, 16, 17, 18, 21, 22, 24, 25, 26, 27, 28, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 44, 51, 52, 53.

Navy Regulations and Naval Instructions That Concern the Hospital Corps and With Which Hospital Corpsmen Should be Familiar.

The Medical Department, Hospital Ships, and Medical Officers, Chapter 27, Navy Regulations.

The Medical Officer of a Ship, Chapter 19, Naval Instructions.

Duties of a Pharmacist, R 3236 and I 2351, 2352.

Appointment of Pharmacists, R 3317.

Classification of Pharmacists as Staff Officers, R 1013.

General Duties of Chief Pharmacist's Mate, R 3402.

Enlistment of Hospital Corpsmen, R 133 and 3525.

Rating, Promotion, etc., Hospital Corps, R 3551 (pp. 7 and 8).

Pay of Hospital Corps and Nurse Corps, R 4427 and 4428.

Instruction of Members of Hospital Corps, I 2642.

Duty of Hospital Corps Restricted, R 1540.

Division on Board Ship to Which Hospital Corpsmen Belong, I 2130.

Hospital and Ambulance Service Performed by Hospital Corpsmen, I 3261.

Hospital Corps, Members Forbidden to Have Any Financial Dealings with Patients, I 3260.

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